Railway Age Gazette
MECHANICAL EDITION
INCLUDING THE
AMERICAN ENGINEER

PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY,
WOOLWORTH BUILDING, NEW YORK, N. Y.

CHICAGO: Transportation Bldg. CLEVELAND: Citizens' Bldg.
LONDON: Queen Anne's Chambers, Westminster.

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Subscriptions, including the eight daily editions of the *Railway Age Gazette* published in June in connection with the annual conventions of the Master Car Builders' and American Railway Master Mechanics' Associations, payable in advance and postage free:

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| United States, Canada and Mexico | $2.00 a year |
| Foreign Countries (excepting daily editions) | 3.00 a year |
| Single Copy | 20 cents |

Entered at the Post Office at New York, N. Y., as mail matter of the second class.

**WE GUARANTEE**, that of this issue 6,600 copies were printed; that of these 6,600 copies 5,235 were mailed to regular paid subscribers, 250 were provided for counter and news companies' sales, 222 were mailed to advertisers, exchanges and correspondents, and 893 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 32,500, an average of 5,417 copies a month.

The **RAILWAY AGE GAZETTE, MECHANICAL EDITION** and all other Simmons-Boardman publications are members of the Audit Bureau of Circulations.

VOLUME 89 JUNE, 1915 NUMBER 6

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### Prevention of Damage to Lading

Even with the great improvements made during the past few years, there is still much to be desired in some of the box cars which are in regular service, as regards the damage to and theft of lading. To a considerable extent this problem centers on proper doors and fastenings. There are still in service many cars with bottom door guides which are totally inadequate so far as gaining entrance to the car without breaking the seal is concerned. Weather strips are in many cases entirely useless when it comes to preventing the entrance of rain and cinders driven against the car. Many of the cars which have been for years in service have been brought up-to-date in these respects, but there are still many which are defective and moreover there are cars now being placed in service for the first time that are poorly constructed. There are still far too many new cars which seem to be neither designed nor built but merely put together and this fact is generally traceable to the officer who has the last word in the matter of expenditures. It seems impossible to convince some of these gentlemen that while a car is a car, it is not necessarily a good car, and as long as such officers prefer to save money in first cost and as a result spend more money in maintenance expenses and the settlement of loss and damage claims, badly designed and poorly built freight equipment will continue to be added to the country's rolling stock.

### High Water and Superheaters

In the discussion on methods of treating locomotive boiler water at the recent convention of the Master Boilermakers' Association, it was stated that with treated water, in the case of superheater locomotives, considerable foaming can apparently occur and the water that is carried over to the superheater elements will be dried out and delivered to the cylinders in the form of steam. In bad water districts this is, at times, unavoidable, but it would seem that there are still some railroad men who do not realize the effect of such conditions on the operation of a superheater locomotive. The campaign of education which has been carried on throughout the country to prevent enginemen carrying the water too high on superheater locomotives has been eminently successful, but in view of the foregoing it might not be amiss to again call attention to the bad effects which result from using a superheater as a steam dryer. Setting aside the question of possible damage to the superheater, the device loses a part of its heating surface under such conditions in order to help the boiler in evaporating the water. This is a purpose for which the superheater was not intended and for which it should not be used. Its heating surface, when compared with that of the boiler to which it is applied, is so small that comparatively little water passing over will appropriate so much of the heat that should go to superheat the steam, that the device, as a superheater, may very easily be made useless. A high degree of superheat is absolutely necessary to efficient performance in superheated steam locomotives and if a portion of the superheating surface is given over to the evaporation of water the degree of superheat obtained will be proportionately lower. It must be borne in mind that the superheater cannot be expected to give the results for which it is intended if it has to assist in the work which should be done by the boiler.

### Sweeping Changes in Officers

It is difficult to understand the reasoning of a man who, when placed in charge of a railway organization, or a part of one, begins deliberately to pull it to pieces. We refer particularly to cases arising from time to time in which the previous officer has died or left the road for service elsewhere, and in which the organization has been known for its effectiveness. A superintendent of motive power, for example, when appointed under such conditions may start to "clean out" the motive power department staff. If he is a man who has been

"brought up" on that particular road, the changes which he makes are likely to be because of personal animus or inability to get along with certain individuals; and whether he be promoted or brought from another road, he is quite likely to make a number of changes, just to "make a showing." If men of this caliber were to stop and think carefully over such proposed changes before they are made, it is not likely that so many of them would be made. Changing officers who are known to be producing results is likely to prove expensive. The new man not only has to learn the conditions about him and become familiar with his subordinates, but he may take it into his head to take a leaf from his superior officer's book and institute a house-cleaning himself. It does not take any great amount of perception to see that moves of this kind are likely to have results similar to that of pushing over the first of a row of dominoes.

And who pays for it all? The railroad company, of course. In order that one officer might "make a name for himself," an organization is abruptly torn to pieces, and has to be slowly and painfully put together again—slowly, because no efficient organization can be made overnight; and painfully because the new men, in becoming accustomed to their duties and learning to work in harmony with other departments, necessarily make mistakes which are very likely to cause engine and train delays and otherwise increase expenses. Admittedly, the new organization may eventually prove superior to the old one; but who can say that the old one could not have been made just as effective, and that without any preliminary upheaval? We have nothing to criticize in the changes made by an officer who has been placed in charge of a department which everyone knows was in bad condition; but even in such an instance the new man can afford to move slowly. The really big man in any case will make no change until convinced beyond a doubt that a change is necessary. We seriously doubt whether the "make a showing" tactics referred to really ever produce any remarkable and lasting results, and the man who practices them is more than likely to show only that he himself is not big enough to realize what an effective and efficient organization is.

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**Railway Fuel Convention**

The most interesting subject presented for consideration at the seventh annual convention of the International Railway Fuel Association was that of pulverized fuel. The author of the paper, W. L. Robinson, of the Baltimore & Ohio, is to be congratulated upon the thoroughness with which he covered the field. The members were enthusiastic on this subject, many being of the opinion that by the use of pulverized coal the operation of the steam locomotive would be brought almost to perfection. Those who are the beginners in employing this method of firing must be prepared to meet the disappointments that are bound to occur with newly developed methods, but it is only by a willingness to experiment that the use of pulverized coal can be developed to the limit of its possibilities.

The committee reports on mechanical stokers and fuel stations are of special interest. Regarding the former, the association goes on record as to the permanency and necessity of the locomotive mechanical stoker for certain conditions. The report contains information obtained from various railroads replying to a list of some 25 or 30 questions. It brings the purposes, the operation and the value of the stoker clearly before the reader in a very concrete form. The committee on fuel stations presented very good information regarding methods of storing coal at the coaling stations.

Perhaps the most striking point brought out throughout the discussions was the seeming lack of interest displayed in fuel economy by persons other than those directly responsible for the fuel. It was felt that if more active consideration were given by the higher officers to this subject, much better results could be obtained. The fuel men should so fortify themselves with arguments and figures that they would have little difficulty in showing their superiors just what they could save by being given additional authority or an increased supervising force. With about 25 per cent of the total transportation expenses chargeable to fuel, what may seem small percentages in savings may really mean considerable sums of money. It behooves each member of the Fuel Association, therefore, to boost on fuel economy. He has every opportunity to win his case.

The attendance at the convention was noteworthy, especially on account of the tendency this year for roads to refuse to pay the expenses of their men at the various conventions. The Baltimore & Ohio, one of these roads, was represented by 19 men, all paying their own expenses. This surely is a tribute to the association of which every member should be proud.

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**The Special Apprentice**

Elsewhere in this issue will be found a communication from a special apprentice who questions the value to the apprentice as well as to his employer of certain methods followed in the training of special apprentices. This reopens a discussion to which much has already been contributed with, we fear, but little effective result. It is evident from the amount of discussion which has taken place, however, that the special apprenticeship course usually found in the railway mechanical department leaves much to be desired. The apprentices complain of the length of the course and of the opportunities offered, as well as of the treatment to which they are subjected. Mechanical department officers and foremen are often disappointed with the services rendered by the special apprentices and contend that their future is largely in their own hands. So far the remedies suggested have almost exclusively dealt with the length and adjustment of the course. They have dealt with the symptoms of the malady but have not touched its source.

In the traditions of the railway mechanical department the college man plays but a small part. The training of the mechanical department officer has long begun with his trade apprenticeship at such an early age as to preclude the possibility of attaining more than a common school education. The need of college men in the department has long been felt but the problem of creating a practicable avenue of entrance has been difficult of solution; indeed it has not yet been solved. The young man who has spent four years or more in acquiring a technical education very naturally feels that he cannot afford to enter railway service as a regular apprentice in competition with others who are from four to six years younger. He expects, to a certain extent, immediately to capitalize the training he has received; hence the necessity of the extra inducement in order to secure his services at all. The special apprenticeship course is the inducement now offered, and many college men take up the work of such a course under the false impression that they are to be given a short cut, from which the rough places have been eliminated, to a high place in the organization. Disillusionment comes after a few weeks of sore muscles and blistered hands and with it a feeling of resentment. Of course, not all apprentices succumb at this stage in their development; those of the right stuff in time readjust themselves to the actual conditions and settle down to make the most of the many opportunities which lie in their path. The point is, however, that what is intended as a special inducement is in reality a handicap both in securing the right kind of material and in its best development when once secured. Another evil of the special apprenticeship system lies in the fact that it practically limits the development of those who enter the service at the bottom as regular apprentices, creating a condition at the outset which is fundamentally wrong.

The elements of a better solution of the problem may be found in the methods employed in the instruction of regular apprentices on many railroads at the present time. The need of certain standards of education for mechanics, higher than possessed by the average applicant for apprenticeship, has led to the inclusion of class-room work in the regular apprenticeship course, a practice which has been amply justified by its results. If the maintenance of school facilities for the education of prospective mechanics is

economical, are the railways not equally justified in making some provision for the higher education of prospective officers selected from tested material? Scholarships in reputable technical institutions properly equipped to teach railway mechanical engineering could be developed to fulfill admirably the requirements of the railways. These could then be filled from the ranks of regular apprentices, just as some of the American Railway Master Mechanics' Association scholarships are now filled. Such a plan would undoubtedly require a greater outlay by the railroads than does the present system of special apprenticeship, but the result would be far better. The grounds for the misunderstanding which so frequently exists between the college man and his employer would be removed, and the elimination of those unfitted for railway mechanical work, or for positions of responsibility, would take place before, instead of after, several years have been wasted in expensive preparation for the work. Young men thus receiving their early training in the mechanical department will return to the service after a college course with a true perception of the relation of theoretical training to practical results—something which the special apprentice acquires only after much disappointment and readjustment.

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**The Art of Braking Trains**

The advent of the steam locomotive with the consequent increase in the speed of movement as compared with the previous methods of transportation created the problem of braking, which previous to that time had been successfully solved by the simplest of mechanical appliances. That the need of more effective means of controlling the speed of trains was evident early in the development of railroading is shown by the fact that during the first two-thirds of the nineteenth century more than 600 patents covering brakes of various kinds for railroad service were granted in England, while about 300 were granted in the United States. The real history of successful train braking, however, began in 1872 when George Westinghouse brought out the first automatic air brake, this undoubtedly being the greatest single advance step in the development of the art. The underlying principles in the construction of this brake are universally adhered to in American practice today, and its further development has been a large factor in increasing the speed and weight of trains, which has resulted in increasing the efficiency of the service rendered by the railroads.

With the light equipment and comparatively short trains handled during the early days of the automatic air brake the functions essential to satisfactory train control were comparatively few and the apparatus was simple. The maximum conditions in freight service did not then exceed 40 or 50 cars per train with a maximum capacity per car of 50,000 lb., while passenger trains did not often exceed five or six cars of light wooden construction. Today freight trains of 100 cars are not uncommon, many of the cars having a capacity of 100,000 lb. and even greater. Passenger equipment has more than doubled in weight and trains of 15 or 16 cars are often handled. Under present conditions the simple functions of the early automatic brake are entirely inadequate and in meeting the changes in conditions many changes in the air brake apparatus have been made. As new functions have been required new apparatus has been added to the equipment until today the triple valve has been replaced on the locomotive and is being replaced on heavy passenger coaches by apparatus involving many complications. With the new equipments better results are obtained under the modern severe conditions than were obtained with the old equipment on shorter and lighter trains. The apparatus, however, has become so complicated that it is the work of a specialist to acquire even a general knowledge of its construction and maintenance.

One of the great needs in the field today is the simplification of the means employed in brake operation. This statement does not imply a lack of appreciation of the results accomplished by the present trend of development, which has undoubtedly taken a logical course, but we believe that we are voicing the opinion of many railroad men in stating that such a simplification is now greatly to be desired, from a maintenance standpoint as well as in order to further the development of better freight train control. With brake equipment now being placed on passenger train cars the engineman has as perfect control over brake cylinder pressure as though each cylinder in the train were supplied with air direct from the locomotive. With freight train cars, however, this is not true and to maintain effective cylinder pressure against brake cylinder leakage, release and reapplication are still necessary. While perfect control of brake cylinder pressure may not be as essential in freight as in passenger service it is none the less desirable. Such control is not impossible of attainment at the present time but the cost of the necessary apparatus as well as the conditions under which it would operate are prohibitive from a practicable standpoint and it can best be made available for freight service by a reduction of the complexity of the appliances required.

It would therefore seem that the advantages to be gained by a modification in the present systems of air brake control, whereby the advantages of such functions as the maintenance of uniform and constant brake cylinder pressure regardless of cylinder leakage and unequal piston travel, and others now possible in passenger service may be made available for freight service, are worthy of the serious consideration of the builders of air brake equipment as well as of the few railroad men who are specialists in air brake performance and maintenance. Whether such a result is possible of practicable attainment is not our place to say; it is not inherently impossible, however, and the need is great.

## NEW BOOKS

*Proceedings of the American Electric Railway Association.* 555 pages, 6 in. by 9 in. Illustrated and indexed. Bound in cloth. Published by the American Electric Railway Association, 29 West 39th street, New York.

This is the complete proceedings of the American Electric Railway Engineering Association's twelfth annual convention, held at Atlantic City, N. J., October 12 to 16, 1914, and contains much valuable information concerning engineering as applied to electric railways. The printing is especially good and the illustrations clear, the latter including a number of insets.

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*Tests of Metals and Other Materials.* Bound in cloth. 213 pages, 5½ in. by 9 in. Illustrated and indexed. Published by the United States War Department, Washington, D. C.

This book comprises the 1914 report of the tests made on metals and other materials with the United States testing machine at Watertown Arsenal, Mass. The tests covered are those up to June 30, 1914, and include tests on steel columns, chains, wire and manila rope, proof stresses on piston rods as well as metallographic examinations. A large number of illustrations are included, among them being several insets and the entire work is done with the usual high quality of the government printing office at Washington.

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*Rules for the Construction of Stationary Boilers.* Bound in paper. 114 pages, 6 in. by 9 in. Published by the American Society of Mechanical Engineers, 29 West 39th street, New York. Price 80 cents for individual orders; 40 cents per copy in lots less than 1,000; 30 cents per copy in lots of 1,000 to 2,000, and 20 cents per copy in lots of 2,000 or over.

This book constitutes the report of the committee of the American Society of Mechanical Engineers to formulate standard specifications for the construction of steam boilers and other pressure vessels and for their care in service. This committee is known as the Boiler Code Committee and has spent several years on the development of this set of rules. Its members comprise some of the most eminent mechanical engineers in the country, and every endeavor has been made to formulate a set of rules which will be thoroughly practical and can be adopted in their entirety by any state or municipality.

# COMMUNICATIONS

## THE SPECIAL APPRENTICE

Reading, Pa.

To the Editor:

I have read with great interest the articles about apprentices and apprentice instruction, appearing from time to time in your columns. In line with a request in an editorial in your April issue, I wish to make the following suggestions:

It seems to me that special apprentices in American railroad shops spend too much time in one place. For instance, why should they be kept at such work as tapping holes in boilers for a month or more—an operation which anyone can learn in one or two days? Is it not a waste of time to spend weeks on a class of bench work that is every day the same, and can be done as well by laborers? There are many cases of this kind. When a special apprentice has spent a good many years in school, it is to his interest, as well as that of his employer, that he have an opportunity to learn something new every day, and not to be forced to do the same work over again and again. There has been much discussion as to why so many apprentices leave railroad work to enter other fields. I believe that if they were kept interested in their work, as they would be if they were moved about more frequently, they would stay with the railroad.

Furthermore I would recommend that during their course special apprentices be placed in charge of a small gang to find out which ones are qualified to become foremen. There are many men who can do good work themselves, but are unable to direct others, while on the other hand, there are many less skilled workmen who have the ability to supervise others.

Finally, I believe for special apprentices, two years of shop-work should be sufficient. In Germany the college apprentices work only one year, but I believe that is rather short. If a two-year course were adopted, the time could be divided as follows:

| | |
|---|---|
| Machine shop | 4 months |
| Air brake department | 1 month |
| Blacksmith shop | 1 month |
| Carpenter shop | 1 month |
| Foundry (Iron and Brass) | 2 months |
| Boiler shop | 2 months |
| Erecting shop | 3 months |
| Roundhouse | 2 months |
| Firing engines | 2 months |
| Car shops | 3 months |
| Drawing room | 3 months |
| | 24 months |

This should be long enough to acquire a fair knowledge of the work done in each department. When his course is completed he could be kept in the drawing room until other work is available.

Hermann Schoenen.

## KEEPING UP STANDARDS ON METALLIC PACKING EQUIPMENT

Chicago, Ill.

To the Editor:

It has occurred to the writer that railroads could save quite a bit of money and obtain much better results with metallic packing, all makes considered, if all vibrating cups were made in one shop. Very few roads do this, although the cups could be made more uniformly and a great deal cheaper if they did. The main objection of mechanical department officers is that the cups are usually bored to fit the rods. Granted; but why not leave that part of the cups small, and when a new cup is required simply draw one from the storehouse and bore it out to fit the rod? I venture to say that vibrating cups made in quantities with the proper tools and devices can be made for one-half what, for instance, a small roundhouse shop could make them; also—and here is the main reason for having cups made in one shop—the cups will all be alike over the entire system. The writer has seen about 57 different varieties of the same type of cup on one road, some made without even a template. How can the same packing possibly fit more than one kind of cup?

In the making of vibrating cups even a poor system and standard is better than none. Of course, it should be patent to anyone that some real standard should be adopted for each kind of packing used; then all the cups should be made to that standard. Solid reamers should be used and these kept to a standard by a master cup, or some other good method to insure uniformity. It would probably surprise the mechanical department officers after a few months to note that a great deal less packing was being used and that what was used was working the way it should. The writer would be very glad to do what he consistently can in the way of suggestions. A. E. M.

## BRAKE HANGING AND THE M. C. B. JOURNAL BEARING

Boston, Mass.

To the Editor:

There seem to be two common misconceptions concerning brake hangers; one is that the hanger on the forward wheel is placed in compression immediately when the brake is applied; the other is that the angle of the hanger has an important bearing on the chattering of the brake. Yet the behavior of the apparatus does not agree with these conclusions.

In the figure $AB$ is the force with which a brake is applied. At high speed the coefficient of friction between the wheel and shoe is low; $AD$ represents the resultant reaction of the wheel against the shoe with a coefficient of friction of 0.125, $AC$ being the pressure between them. The combination of $AB$ and $AD$ gives $AF$, the resultant stress in the hanger, in this case tension. As the speed is reduced the coefficient of friction increases. The

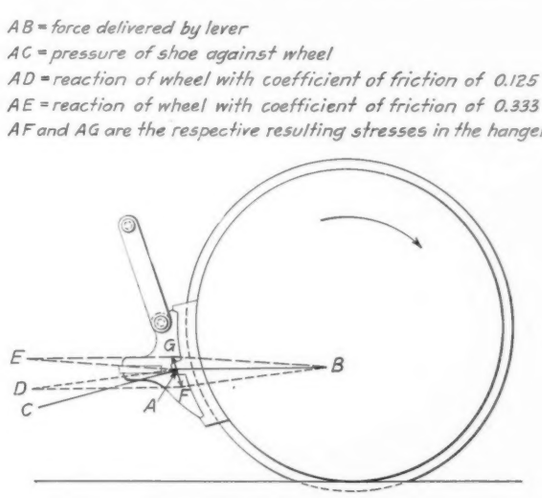
AB = force delivered by lever
AC = pressure of shoe against wheel
AD = reaction of wheel with coefficient of friction of 0.125
AE = reaction of wheel with coefficient of friction of 0.333
AF and AG are the respective resulting stresses in the hanger
E
D
C
A
G
F
B

**Diagram Illustrating the Stress in Brake Hangers**

resultant stress in the hanger is the compression, $AG$. As the coefficient increased, it passed through a certain value, about 0.25, which resulted in no stress in the hanger. A slight further increase throws the head quickly upward. When the slack is taken up, the elasticity of the hanger throws it down, because the tendency to compression is still slight. This is repeated until the increasing friction stops it, and we know this action as "chattering." It does not begin until speed has been reduced, and usually stops just before the train stops.

A brake hung at the height of the center of the wheel would throw its hanger into compression at once, and should not chatter. It would have the further advantage of being unaffected by the height of the springs as determined by the load in the car, and would be in an ideal location. The only objection to this seems to be the effect on the journal bearing. Has not the time come when the bearing should be extended down the sides of the journal? There is naturally much reluctance about changing standards, but additional parts and maintenance expense are often resorted to for advantages of less importance. G. E.

# FUEL ASSOCIATION CONVENTION

## Papers on Powdered Coal, Prevention of Smoke, Fuel Stations, Mechanical Stokers and Fuel Oil

The seventh annual convention of the International Railway Fuel Association was held in the La Salle Hotel, Chicago, May 17 to 20, D. R. MacBain, superintendent motive power and rolling stock New York Central west of Buffalo, presiding. The convention was opened with prayer by Rev. John W. Nicely.

### PRESIDENT'S ADDRESS

Mr. MacBain said in part: "I am a great believer in the educational phase of the question of fuel. To render efficient service economically in any particular line, familiarity with its details is essential, and this is the more particularly true, perhaps, in the case of the man who actually handles the coal between the locomotive tender and the firebox. For fuel might be purchased with the utmost skill, receive the best attention as to grade and preparation by the railroad company's inspectors, be carefully passed from the coaling plant to the tender and then might be subjected to the grosses kind of misuse and extravagance. The firemen need practical instruction on the road, the more they get the better, and the more efficient and economical will be their services. With this practice in vogue, I am positive that the salaries of the instructors will appear as assets, doubled and trebled, on the auditors' books."

### ADDRESS BY MR. SCHOYER

A. M. Schoyer, resident vice-president, Pennsylvania Lines West, made a most interesting address after commenting on the very creditable work of the fuel association. In his address, he said in part:

"It seems to me that one of the burning questions of the day, from a railroad standpoint, is, What shall the railroads do either to offset the continuing demand for increased wages or to get the relation of employer and employee on a sounder basis, where right will be considered, instead of might or expediency?

"Three remedies have been suggested—first, government ownership of railroads. With ward politicians acting as general managers, state politicians handling the policy, national politicians handling the finances and labor leaders handling the labor questions, there would be no need of arbitration for the wages would be increased upon the asking. With the railroads in the hands of the government, with rates probably continually being decreased, in order to favor special lines of voters, and with wages being increased to favor special lines of labor unions, with incompetent supervision of details the growing deficits would have to be raised by taxation, and it is quite certain to my mind that the result of such losing operations would be that the credit of the government would suffer and rates of interest go higher and higher.

"The second solution, which has been suggested, is that if the law should provide and the Interstate Commerce Commission should authorize that whenever railroads must through arbitration increase the wages of the employees in any branch of service they be also authorized to increase their freight rates automatically. If an arbitration should give the men an increase of wages of 6 per cent, then the railroads should be authorized to increase freight rates, say 3 per cent. How long the public generally would stand it I do not know.

"With very great diffidence I bring forward a third solution, compulsory arbitration. Not arbitration as under the Canadian law, which is not entirely compulsory; not arbitration as under the American law, which is entirely optional; not arbitration as exists in any country today; but a law which would compel employer and employee to submit their differences to a court of arbitration, after having done all they could together to solve them. The law should require that no lockout or strike should occur hereafter on railroads. The decision of the court should be binding; not to be appealed from, except as to errors of law appearing on the record. Neither the employers nor the employees would be willing to go to the limit of submitting matters to this court unless they were assured of the justice of their positions, and, in the course of time, labor and capital, as applied to the railroads, would find their own relations."

### POWDERED COAL*

BY W. L. ROBINSON

Supervisor of Fuel Consumption, Baltimore & Ohio

Coal in a finely divided or powdered state repreesnts the most advanced method for producing perfect combustion, thereby making it possible to more nearly obtain the full heat value of the fuel than by any other known means. While a cubic inch of solid coal exposes only 6 sq. in. for absorption and liberation of heat, a cubic inch of powdered coal exposes from 20 to 25 sq. ft., which enables the more uniform gas production from the volatile matter in the coal and the more prompt and perfect intermingling of gas and air, thereby improving combustion and reducing smoke. Furthermore, there is no cooling of the fire by heavy intermittent charges of fresh coal, and consequent production of lost heat, as with hand or stoker firing on grates.

The generally recognized waste, unsalable or otherwise low-value coal mine products, such as culm, slack, mine sweepings and dust, are suitable for converting into the powdered form. Therefore, much fuel that is now going to waste could be advantageously mined and utilized. The railways should utilize as much as possible of the inferior grades and qualities of local fuel supply available, in order to conserve the better mine output for commercial revenue tonnage in the domestic and foreign trade.

In general, powdered coal, to give the best results as regards complete combustion and the least trouble as regards ash and slag, should contain not more than 1 per cent moisture, and be of a uniform fineness, so that not less than 95 per cent will pass through a 100-mesh, and not less than 85 per cent through a 200-mesh, and not less than 70 per cent through a 300-mesh screen. The cost for preparing powdered coal will vary with the cost for the raw coal and its moisture content. However, a general average from available data covering periods of the past five to ten years at cement and metallurgical plants will enable the following conservative estimate, assuming the cost of the raw coal at from $1 to $2 per short ton, and that it will require crushing and have a moisture content of from 5 to 10 per cent, when placed in the dryer.

| Capacity of plant in short tons per hour | Average total cost for preparation per short ton |
|---|---|
| 2 | From 25 to 50 cents |
| 3 | From 20 to 45 cents |
| 4 | From 16 to 40 cents |
| 5 | From 14 to 35 cents |
| 10 | From 12 to 30 cents |
| 25 | From 10 to 20 cents |

The fuel required for drying the coal will average from 1 to 2 per cent of the coal dried. The distribution of the total cost may be approximately stated as:

| | |
|---|---|
| Fuel for drying | 10 per cent |
| Power for operation | 30 per cent |
| Labor | 30 per cent |
| Maintenance and supplies | 25 per cent |
| Interest, taxes, insurance and depreciation | 5 per cent |
| Total | 100 per cent |

The cost for preparing powdered coal should be more than offset by the ability to utilize the cheaper grades of fuel.

Finely divided coal dust gives off gas at normal atmospheric

*See also article on "Pulverized Fuel for Locomotives," published in the *Railway Age Gazette, Mechanical Edition*, May, 1915, page 213.—[EDITOR.]

temperature, but any pulverized coal coarser than that which will pass through a number 100-mesh screen is liable to explosion only when distilled by the heat or compression of a primary ignition. The finer than what will pass through a number 100-mesh screen carries no danger unless combined in a dry state, in floating suspension in nearly still air and mixed with the requisite amount of oxygen at the requisite temperature to produce "chemical tension" or primary ignition.

Powdered coal may be burned by either of two generally defined methods: The first, or long-flame method, constitutes a progressive burning of the coal. This combustion is accomplished by projecting the primary air which carries the fuel into the furnace with high velocity, the additional air (about 75 per cent) required for combustion being blown or induced into the furnace from other sources. The second, or short-flame method, has been the latest development. This process involves a flame of relatively short travel, and consists of admitting the entire air supply needed for combustion into the furnace with the fuel at low velocity. In the application of powdered coal to a New York Central locomotive, a combination of the long and short-flame methods has been used.

In general, the equipment essential for burning powdered coal in locomotives are: An enclosed fuel container; means for conveying the fuel to the feeders; means for commingling the fuel with air at the time of and after feeding; supplying the proper amount of air to produce a combustible mixture at the time the fuel and air finally enter the furnace; a suitable refractory-material furnace in the firebox; means for disposing of the slag; means for producing the proper draft through the furnace and the boiler; means for harmonizing the draft and the combustion; suitable power for operating the fuel and air feeding mechanism, and an automatic and hand control of the fuel and air regulation.

It is understood that the developed equipment for burning pulverized fuel can be readily applied to all existing modern types of steam locomotives without any changes in the fireboxes except to install arch brick supporting tubes, where fireboxes are not now equipped, and to remove the grates, ashpan and smokebox draft appliances. There is no equipment in the cab except the automatic hand control, which is placed in a position convenient to the fireman. The enclosed fuel container is suitable for either powdered coal or fuel oil, and either kind of fuel can be used by merely changing the feeding equipment. The total weight of the equipment applied will about equal that of the equipment removed.

For firing up a locomotive, the necessary draft through the boiler is obtained by means of the usual stack steam blower, after which a piece of lighted waste is placed in the fuel and air conduit leading to the firebox, and one of the fuel feeders is started.

### SOME BENEFITS TO BE DERIVED FROM ITS USE

With powdered coal the tendency toward the more uniform, intense and sustained firebox temperature, as well as the automatic, continuous stoking of the fuel and the burning in suspension; feeding of practically dry fuel to the furnace; reduction in the clogging and leakage of flues and the reduction in the various heat losses, should all tend to maintain the boiler capacity at its maximum effectiveness under varying operating conditions.

Through the burning of powdered coal in suspension, the necessity for over or under-feeding fuel to grates or retorts is eliminated, and as there are no grate fires to require cleaning, it enables the establishing of the most economical length of locomotive run for the train service to be performed, and the reduction of engine house terminals. As locomotives burning oil are being regularly and successfully operated on runs from 300 to 450 miles each way, the same should be entirely feasible when burning powdered coal.

The use of bituminous coal in a powdered form seems to be the logical solution of the smoke, cinder and spark questions at engine houses, terminals and on the road, and one that should greatly reduce the loss of heat and fuel cost resulting from imperfect combustion in existing and future steam locomotives.

The elimination of ash pans, grates, smokebox, diaphragm, baffles and nettings substantially reduces the retardation of the products of combustion through the boiler.

Furthermore, the coal is not touched by the hand or shovel from mine car to furnace and there is no loss by pilfering, dropping from the tender container, gangways, through holes in deck, or by firemen shoveling undesirable fuel off the tender on right-of-way.

When powdered fuel is used, the refractory-material furnace retains its heat and prevents the chilling of the firebox and flues, even though the supply of fuel may be cut off and therefore reduces the liability of firebox leakage.

When being worked at from one-half to maximum boiler horse power capacity, a locomotive boiler equipped with a superheater will range from 65 to 55 per cent boiler efficiency, this being representative of the best grate fire practice. Taking into consideration the effect of burning powdered coal in suspension on the various heat losses enumerated, it is most conservative to place the saving to be effected at 25 per cent of the coal fired, actual performance to date having shown as high as from 30 to 40 per cent saving.

The time required for building, cleaning or dumping fires at terminals and cleaning flues and smokeboxes on steam locomotives represents a large percentage of the maximum non-productive delay to power, and is directly responsible for much road and yard crew and shop labor expense. With powdered coal there are no grate fires to clean; the extremely fine nature of the ash and absence of cinders causes practically no accumulation in the flues or smokebox.

As the sulphurous and other poisonous gases resulting from combustion tend to precipitate with the liquid ash into slag, the poisonous and suffocating effect of the products of combustion emitted from the stack is materially reduced.

The use of powdered coal (due to absence of cinders, sparks, ashes, etc.), would reduce cementing of ballast and lack of drainage of roadway, burned out ties and the cost for forking ballast. With powdered coal and automatic mechanical mixing of the fuel and air and its combustion in suspension, no manual labor is required, and the human element is practically eliminated.

### DISCUSSION

The members participated freely in the discussion, there being some skepticism as to the ultimate outcome of the use of powdered coal. E. H. Stroud, of E. H. Stroud & Company, stated that the coal must be powdered to the correct fineness and that it must be uniformly fine if the best results are to be obtained. Complete combustion must be obtained to prevent the formation of cinder slag and if the furnace is correctly designed there should be no trouble with the accumulation of slag on the flues. The air and the fuel passed through the burner should be definitely measured, and to accomplish this he strongly recommended that the air necessary for the complete combustion of the powdered fuel be admitted only through the burner. Where air is used to separate the fine from the coarse particles in the process of pulverizing—a coal with 10 per cent moisture will be reduced to 7 or 8 per cent moisture. He also recommended a lazy flame, stating that in stationary plants this would give a temperature that could be regulated from 1,800 to 3,600 degs. F. In this same service savings as high as 50 per cent in fuel of a low price have been made. He gave estimates of 15 cents per ton as the cost for pulverizing fuel at the rate of 5 tons per hour and 4 to 5 cents per ton for drying the coal. From his experience he found that a draft of only ⅜ in. (water column) was required. He recommended a coal with not less than 25 per cent volatile.

Joseph Harrington, of the Powdered Coal Engineering & Equipment Company, called attention to the effect the use of

powdered coal on locomotives would have in postponing the necessity of electrification at large terminals such as Chicago, and spoke to some extent on the large field this type of fuel offers to the railroads.

J. E. Muhlfeld, president of the Locomotive Pulverized Fuel Company, presented a written discussion, in which he confirmed the conclusions derived from Mr. Robinson's paper. He showed that if the powdered coal equipment was applied to all types of locomotives an annual saving of millions of dollars could be made in the cost of fuel to the railways, and that the operation of the locomotives would depend less on the physical capacity of the firemen.

Other speakers who have had experience in the use of powdered coal spoke strongly in its favor, and all called attention to the necessity of having the powdered fuel dry, the maximum moisture being placed at 2 per cent. The users of this fuel find it expedient to keep only 48 hours' supply on hand to prevent the possibility of the coal to absorb too much moisture.

Mr. Robinson stated in his closure that tests have shown that only 15 lb. of dust was found in the locomotive front end after a test of two weeks and that evaporation of 8½ to 12 lb., from and at 212 deg., had been obtained.

## ANALYSIS OF DEPENDENT SEQUENCE AS A GUIDE TO FUEL ECONOMIES

BY HARRINGTON EMERSON
The Emerson Company, Efficiency Engineers, New York

With a good steam engine, a good furnace and a good boiler, a horsepower can be produced from one pound to a pound and a half of coal. The steamers of the Inch Line have long records of one pound per 1 hp. The Lusitania, with all her auxiliaries, used about 1.5 lb. The indicated horsepower generated by all the locomotives of the country when pulling trains, divided into the total fuel, amounts to between 4 and 6 lb. I intend to speak of such attainable ameliorations in our locomotive practice as might reduce the 6 to 4, the 4 possibly to 3.

To bring about attainable reductions, there are three essentials: Complete knowledge of what is taking place from mine to ash pit; an organization that is capable of taking hold of the subject; an organization that is competent to solve the problems.

The first step towards the solution of the problem is to set down what we do know of all the steps from mine to ash pit. It will be found that there are some sixty different, distinct steps and that they form what is technically called a dependent sequence. Unlike the links of a chain, which are in dependent sequence, the use of coal is one in which any loss that occurs in the first term is carried on into the second, the losses in the second link or term are carried on into the third link, and we suddenly find we have frittered away all the strength there was.

DEPENDENT SEQUENCES IN COAL USE IN LOCOMOTIVE OPERATION

| Sequences | | | | |
|---|---|---|---|---|
| 1 to 23 | 23 | A | Administrative inefficiencies ..... | 51 per cent |
| 24 to 32 | 9 | B | Shrinks in quantity between purchase and use | 92 per cent |
| 33 to 45 | 13 | C | Wastes due to poor design..... | 69 per cent |
| 46 to 52 | 7 | D | Wastes due to poor firing..... | 71 per cent |
| 53 to 58 | 6 | E | Wastes due to poor running..... | 88 per cent |
| | 58 | | | 20 per cent |

Probably in no case do all the possible losses occur cumulating on any single road, but probably on every road there are at least 30 different kinds of losses. As to each of the fifty-eight a separate analysis would be desirable, an analysis that each must make for himself. I shall content myself with a few indications and a very elementary estimate of the loss that may be occurring.

*A.—Administrative Losses.*—These far exceed all others, but it is the fireman and engineer who get the most blame.

1—Eff. 99.5 per cent. Buying too much coal. Coal costs money and money carries interest.

2—Eff. 96 per cent. Paying too much. This is much more serious. Coal contains B. t. u's, and this is all that makes it valuable.

3—Eff. 95 per cent. Buying wrong kind of coal (clinkering, coking, etc.). The type of coal may make a very great difference.

4—Eff. 94 per cent. Unnecessary transportation. Probably $0.60 a ton is added to cost of coal on long roads by transportation charges, of which $0.06 might be saved by wise routing.

5—Eff. 98 per cent. Unnecessary handling expenses, loading and unloading, detention of cars, etc.

6. Eff. 90 per cent. Wrong sizing of coal. A. G. Kinyon, a recognized authority, estimates the difference between properly sized coal and usual run at 10 per cent.

7—Eff. 98 per cent. Loss in value of coal due to weathering.

8—Eff. 99.7 per cent. Moisture in coal. Even if the coal absorbs 5 per cent of moisture the loss is small, about one-third of one per cent.

9—Eff. 99 per cent. Bad water conditions, indirectly affecting coal consumption. Our experience has been that when water was very bad, coal consumption for similar trains and locomotives is higher.

10—Eff. 95 per cent. Scale on tubes and other fire surfaces. F. W. Foltz, fuel supervisor of the Missouri Pacific, stated that the fuel losses due to this cause were enormous. They undoubtedly might be far worse than the 5 per cent allowed.

11—Eff. 99.7 per cent. Leaks from boiler.

12—Eff. 99 per cent. Broken grates. Causing excess of air and waste of coal before being burned.

13—Eff. 97 per cent. Use of cold water and frequent changes. On a road using 6,000,000 ton, this loss probably amounts to $200,000 a year.

14-15-16-17—Eff. 85 per cent. Terminal and roundhouse losses. Mr. Foltz's estimate of terminal and roundhouse losses is 15 to 30 per cent of total fuel bill.

18—Eff. 98 per cent. Detentions on side tracks.

19—Eff. 99 per cent. Short sidings and other unnecessary see-sawing of trains.

20—Eff. 99 per cent. Uneconomical grades.

21—Eff. 98 per cent. Uneconomical loading.

22—Eff. 98 per cent. Wrong assignment of power.

23—Eff. 98 per cent. Unscientific time schedules. Based on distance rather than grades.

If all these inefficiencies should occur on the same road, only one as high as 10 per cent, many of them less than 1 per cent, the end result would be under 51 per cent.

*B.—Shrinks in Quantity Between Purchase and Use.*—The locomotive is generally charged with coal purchased, not with coal used. These losses are partly due to dishonesty and partly due to carelessness.

24—Eff. 99 per cent. Incorrect mine weights (dishonesty).

25—Eff. 99.5 per cent. Incorrect car weights (carelessness).

26—Eff. 98 per cent. Biased weigher.

27-28-29-30—Eff. 97.5 per cent. Loss in transit (coal that drops off or is thrown off, loss in loading tenders, loss from tenders).

31—Eff. 99 per cent. Diversion from coal in transit. I knew a flouring mill which operated for a year on stolen coal, whole car loads being diverted, after being weighed and charged to coal bunkers.

32—Eff. 99 per cent. There are other diversions, as when coal from bunkers is used for office and roundhouse fires, etc., coal used perhaps for company but not used on locomotives. These dishonesties and semi-dishonesties amount perhaps to as much as 2 per cent. The end result is about 92 per cent.

*C.—Waste Due to Poor Design.*—The best stationary steam engines use about one pound of coal per 1 hp. The ordinary commercial steam engines use from 3 lb. to 20 lb. The conditions under which a locomotive operates are extraordinarily difficult. The power installation is mounted on wheels, the machinery must be rugged rather than accurately finished. Every element of standard operation varies from minute to minute. The fuel, the water, the load varies. It is, therefore, inevitable that severe losses occur from poor design. In good stationary practice 80 per cent of the heat in the coal passes into the water. In locomotive practice very rarely as much as 50 per cent. There is, therefore, a shrink of about 30 per cent in coal efficiency to be charged to design and conditions of operation. Two-fifths of this might possibly be eliminated and if distributed might be apportioned as follows:

33—Eff. 99 per cent. Design of firebox.

34—Eff. 98 per cent. Size of firebox.

35—Eff. 95 per cent. Diameter and length of tubes.

36—Eff. 95 per cent. Front end design. In an English test 375 hp. out of 2,000 was used in creating draft. M. C. M. Hatch, superintendent fuel service, D. L. & W., states that only 19 per cent of front end vacuum is effective at fire.

37—Eff. 98 per cent. Poor ash pan design. Air openings should be 14 per cent of grate openings and about 100 per cent of tube opening area.

38—Eff. 98 per cent. Grate openings.

39—Eff. 95 per cent. Radiation.

40—Eff. 95 per cent. Economies due to compounding do not become manifest unless the pressure exceeds 180 lb. Can be estimated at 5 per cent.

41—Eff. 95 per cent. Economies due to superheat.

42—Eff. 98 per cent. Preventable friction in machinery, valves, pistons, rods, bearings.

43—Eff. 99 per cent. Wheels of different diameter, as either ahead or slightly shifted from middle line.

44—Eff. 99 per cent. The difference in economy between high and low steam pressure is discernible.

45—Eff. 99 per cent. Direction of draft through locomotive. End result is about 69 per cent.

*D.—Wastes Due to Poor Firing.*

46—Eff. 99.5 per cent. Building fires. The loss is relatively great, but on the aggregate, small.

47—Eff. 95 per cent. Smoke and sparks. Too little air. M. C. M. Hatch states that at 2,000 lb. coal fired per hour, the coal loss in sparks is 1.5 per cent; at 7,000 lb. it is 12 per cent. To put the loss in smoke and sparks at 5 per cent is conservative.

48—Eff. 80 per cent. Too much air. This is an invisible but serious loss. Assume 50 lb. excess of air for each pound of coal, the air heated 800 deg. Can lose 0.0686 B. t. u. per lb. per degree. For 800 deg. 54.88 B. t. u's. For 50 lb. excess air this gives 2,744 B. t. u's, or about 20 per cent of the heat units in very good coal. The loss might therefore be 20 per cent.

49—Eff. 98 per cent. Popping and plume—too high pressure.

50—Eff. 99 per cent. Too low pressure. The lower the pressure the less the efficiency of the steam engine.

51—Eff. 99 per cent. Cleaning fires wastefully.

52—Eff. 98 per cent. Dumping fires.

*E.—Waste Due to Poor Running.*—This paper is on a theory and on a method and does not assume to give any proof of the actual losses, which may be more or less than estimated. Undoubtedly losses exist due to poor running, for I have seen letters from firemen narrating the excessive work put on them, and the coal wasted by bad running.

53—Eff. 99.5 per cent. Slipping drivers (harder on the drivers and rails than on the coal pits).

54—Eff. 98 per cent. Full stroke. A train might very easily waste time at a station and the engineer try to make it up by extra steam on the road.

55—Eff. 99 per cent. Throttling in combination with full stroke results in greater steam consumption.

56—Eff. 95 per cent. Dynamometer car tests show variation in horsepower and constant speed when constant horsepower and variable speed is more economical.

57—Eff. 98 per cent. Unwise acceleration. A great consumption of power to gain a few seconds in time.

58—Eff. 98 per cent. Unnecessary braking. End result is about 88 per cent.

If we take the combined efficiency of the engineer and fireman, it appears to be 62.5 per cent, or almost two-thirds. But a test made on a switch locomotive reported in Erie Employes' Magazine showed that current consumption of coal was reduced 65 per cent by care, not 33 per cent. Tests have been made both as to passenger and freight runs, which show actual consumptions under dynamometer-car records amounting to only one-third of usually charged consumption. On such runs, wastes due to poor design and to interest charges, to paying too much, to unnecessary transportation and to unnecessary handling expenses, are not eliminated, nor losses due to weathering.

Eliminating these we would have the following major sequences:

| | | |
|---|---|---|
| A | Administrative inefficiencies | 60 per cent |
| B | Shrinks in quantity | 92 per cent |
| D | Poor firing | 71 per cent |
| E | Poor running | 88 per cent |
| | End result | 34.5 per cent |

This sequence in its end result of 20 per cent to 35 per cent checks up well with the special tests made, checks up well with the difference between coal actually required for horsepower generated and the coal charged to the locomotive fuel account.

To correct the cumulative result in dependent sequence of a number of small evils there should be reliable, immediate and adequate records available from mine to ash pit; an organization capable of handling the problems, and an organization competent to solve the problems.

Railroad locomotive practice is defective as to all these conditions. The records are unreliable, deferred and inadequate. Railroads are very slowly outgrowing the belief that a line officer also necessarily possesses staff competence. The fuel problem is a bigger one than records and a specialized organization. These are the tools wherewith results can be obtained, but before we use tools we must have an organization able to use them, an organization competent to expand and supplement the present cramped type.

DISCUSSION

The paper was well received, the members approving of the broad basis on which it was written. The subject of fuel economies is of so vital importance that all of the higher railroad officers should take an active interest in it. While the mechanical department is directly interested in the consumption of fuel, there are a great number of ways in which the other departments can assist substantially in saving fuel. For this reason it is believed that more decisive action should be taken by the officers in order that the necessary authority be given for a comprehensive and effective fuel economy campaign.

W. C. Hayes, Erie, spoke of some dynamometer tests that had shown that it was possible to operate on 87 lb. of coal per 1,000 ton-miles where 175 to 180 lb. had been considered a good average, illustrating what could be accomplished by proper supervision. A. G. Kinyon believed that the men should be taught to think more concerning their work. The locomotives should be carefully maintained and special attention should be given the steam leaks in the front end, as this is a large source of fuel extravagance.

By looking for and correcting the small imperfections, large savings can be made. The large defects will make themselves known.

## SMOKE PREVENTION

BY E. W. PRATT
Assistant Superintendent Motive Power and Machinery, Chicago & North Western

In 1912 and 1913 elaborate tests were made on the locomotive testing plant of the Pennsylvania Railroad at Altoona, Pa., and a complete report made in 1913 to the American Railway Master Mechanics' Association, with recommendations covering the application of steam-air jets, quick-action blower valves, etc. Since that time practically every locomotive operating in the city of Chicago has been equipped with such apparatus and it has been conclusively proven that soft coal burning locomotives may thereby be kept comparatively free from smoke if the engine crew be given and observe proper instructions at all times.

The smoke inspection bureau of the city of Chicago has accepted these devices as standards and recommends them to those inquiring. This bureau consists of the city smoke inspector, two assistants, ten mechanical engineers and nine deputy observers, covering not only the railroads but the entire city. The expense to the city is about $39,000 per year. The railroads in Chicago have a total of 54 smoke inspectors representing an annual expenditure of about $65,000. A railroad smoke inspectors' bureau, under the direction of a sub-committee of the General Managers' Association of Chicago, has been formed. This is composed of the chief smoke inspectors of all railroads in the city and holds its meetings bi-weekly, inviting thereto all railroad men interested in smoke prevention.

The railroad inspectors are required to report all engines they observe emitting dense smoke on a duplicate post card printed with the form shown herewith. One part of the card is mailed to the joint smoke inspection bureau through the U. S. mails, and the other is sent to the proper officer of the violating road through the railway mails. The bureau makes bi-weekly summaries of the reports for the different roads showing the number of reports filed, the number of locomotives operated in Chicago, the percentage of locomotives reported, the average density of the cases reported and the number of reports made by the inspectors of each railroad. These reports are for the private use of the railroads and are not furnished the city. However,

the work of the railroad bureau is heartily approved by the city authorities and has been productive of greater co-operation between the various railroads, so much so that the smoke reading made by the city the year following its inception was over 50 per cent lower.

At the present time all city inspectors are instructed to each read locomotive smoke for a total of two hours each day. This to be done in one period or in several periods of 15 minutes or more. These inspectors being assigned to various districts in the city make it certain that the railroad observations will not be confined to any one locality. From these observations the city issues monthly and semi-annual reports. All readings are made in accordance with the Ringlemann method of determining smoke density and the *engine minute* is the unit employed. It should be understood that the city smoke bureau construes one minute of No. 3, 4 or 5 smoke as a violation of the law.

An *engine minute* covers the observation of one locomotive during the entire minute. During this minute 14 seconds or less is not counted; 15 to 44 seconds is counted as one-half minute; 45 to 74 seconds is reported as a full engine minute. One-half minute of No. 3 density is 1.5. One-half minute of No. 1 density is 0.5, etc. The per cent smoke density is obtained by multiplying the smoke units by twenty (each Ringlemann unit being 20 per cent) and dividing the product by the total engine minutes.

In order that the city inspectors shall read the smoke density

**JOINT SMOKE INSPECTION BUREAU**
OF RAILROADS OPERATING IN CHICAGO

Date _____ 191__

Inspector _____

of _____ R. R. noted following cases of dense smoke emission on above date:

| ROAD | ENG. NO. | TIME | | DENSITY NO. | LOCATION | REMARKS |
|---|---|---|---|---|---|---|
| | | FROM | TO | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Postal Card Form for Smoke Inspector's Report

correctly, applicants for these positions pass through a probationary period during which time, under the direction of an experienced inspector, they make thousands of smoke readings with a full size Ringlemann chart set up 50 ft. from them in the direction of the stack under observation. These men are under civil service and their standing is based largely on their ability to correctly read smoke density. The members of the Railroad Smoke Inspectors' Association and the city inspectors frequently have joint classes in the reading of smoke density in order that uniformity may be obtained in the case of independent individual observations.

One of the encouraging features of this plan is that it has so fully met with the approval of the city smoke bureau that the latter has voluntarily opened all their record books to members of the railroad bureau, and the reduction in the per cent of density of railroad smoke during the past two years has been remarkable. It is as follows:

| | |
|---|---|
| 1912 | 10.74 per cent |
| 1913 | 6.06 per cent |
| *1914 | 7.41 per cent |

*The figure for 1914 was made up from the Summer reading of 1914 (by old method) and the reading for September, October and November, 1914 (by new method). This figure would be lower but for the change in method.

DISCUSSION

It was believed that with the special devices now applied to locomotives for the prevention of smoke it was a matter of supervision and constant inspection to obtain smokeless firing. The splendid record made by the railroads in the city of Chicago is evidence of this. If the railroads entering other municipalities do not anticipate the demands of the populace they too will find themselves bound by city ordinances. Smokeless firing can be obtained, but the engine crew must be properly instructed and supervised.

## STANDARDIZATION OF COAL PREPARATION

BY H. C. ADAMS
President Jones & Adams Coal Company

The present method of screening has caused no end of trouble in marketing the coal, and various losses to the producer. There is never a time in the year when a market can be found to fit the various sizes that are now being made. This results in large quantities of coal being put on the market for any price the customer is willing to pay. It displaces the size the consumer would ordinarily use and which the operator wants him to use, and destroys any profit that might be secured.

The benefits of standardization are numerous: It would reduce the output to a point where the mine would get running time that would greatly reduce the cost. A great many cars that are now constantly tied up with unsalable sizes would be released and could be used for any other purpose. The operator would not be producing two or three tons of sizes that he has no market for in order to get a ton of the size coal he wants. The railroads for their fuel could use either inch-and-a-quarter lump or mine run, as they deem best, and either of these sizes could be produced in quantities required at all times, for the reason that no unsalable sizes would be produced in order to supply railroad coal. The railways are and should be interested in any move that will benefit the operator. A very large percentage of the freight of some of the roads is coal, and when coal cannot find a market, or perhaps finds an unprofitable market, the railway is sure to feel the effect in the lessened prosperity of the operator and his inability to seek broader markets.

### FUEL STATIONS

The committee deemed it advisable to consider three separate and distinct sub-divisions of the subject as follows: Plant storage for reloading through the medium of cars; plant storage for direct issue to plant, and central storage for distribution to miscellaneous plants. The committee suggests the use of a locomotive crane with a clamshell or similar device for unloading and reloading storage coal, where the amount to be stored is less than 5,000 tons and where the daily issues are small enough to permit of its use.

A cheap method of unloading cars is to use a trestle from which the coal can be automatically dumped. Such a plant could be located adjacent to the coaling station, if the space is not too restricted and the track arrangements permit. Another method is to erect a timber trestle adjacent to the track as shown in Fig. 1, on which locomotives are coaled and grates cleaned, provided with a runway for a locomotive crane equipped with a clamshell or grab bucket. A plank wall or barrier should be placed along the side of the trestle contiguous to the storage pile, to prevent the coal from accumulating under the trestle. A strip of land about 60 ft. wide, and varying in length in proportion to the capacity of the pile would be required for storage. The plan provides for a capacity of 28 tons per lineal foot of coal pile. The coal will be delivered to the coal-receiving track (on the outside of the engine track) in gondola cars of practically any type, from which it will be removed and transferred to the storage pile by the locomotive crane. If desired, this plant may be used for coaling engines either from cars on the receiving track or from the storage pile. It is not considered advisable to use this plant as a locomotive coaling station at terminals where a large number of engines are coaled.

From somewhat meagre figures available it is estimated that with these plans coal can be stored from cars, or reloaded from storage at about 2½ cents per ton.

All new mechanical plants should be so designed as to provide

a storage adjunct to permit of unloading coal into the receiving hopper, from which it may be distributed, either to the plant direct, or to a storage pile when business is dull and there is a surplus of road cars and of coal. The plant must be so designed as to permit of the recovery and issuing of the coal from the storage pile through the plant without the use of road cars.

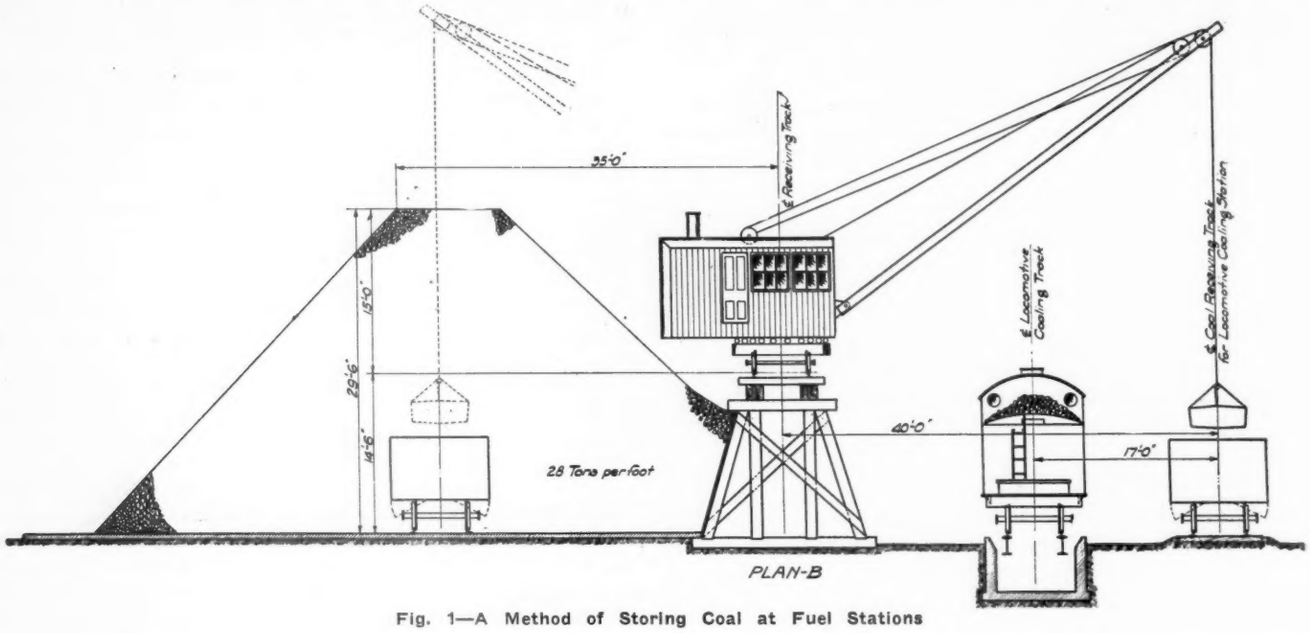


Fig. 1—A Method of Storing Coal at Fuel Stations

The locomotive crane may be used to good advantage for taking care of ground storage in connection with a mechanical coaling station. This plan has been adopted by the Louisville & Nashville, at three places, where large mechanical coaling stations of reinforced concrete and steel construction are being erected. Such a plant is shown in Fig. 2. The receiving hopper is enlarged at the back to form a pit of sufficient size to accommodate the grab bucket of the crane. The crane is located on a circular track back of this hopper, this track centering on the hopper. Coal is dumped into the hopper from the receiving track, and handled to storage by the crane. In reclaiming from the storage pile, coal is picked up by the crane and discharged into the hopper, from which it is handled to the overhead coal pocket in the usual manner. A special crane of 110 ft. radius is used by this road, the gage of the crane track being 20 ft. A 22,000-ton storage is thus obtained with a 12-ft. depth of pile. The crane uses a 3½-ton bucket and has a working capacity of 150 tons per hour. For the most economical operation, such a crane should be electrically operated. Such a plant is estimated to cost $23,000 and has a capacity of 22,000 tons.

With the bridge type, the receiving hopper pit is constructed practically the same as for the locomotive crane. This type lends itself to a much larger storage pile and greater handling capacity than the locomotive crane, but it is, of course, more expensive. The inner trucks of the bridge run on a circular track and are held in position by an arm extending to a central swivel point. The outer trucks also travel on a circular track, the center of the circle being the swivel point above referred to. Coal dumped

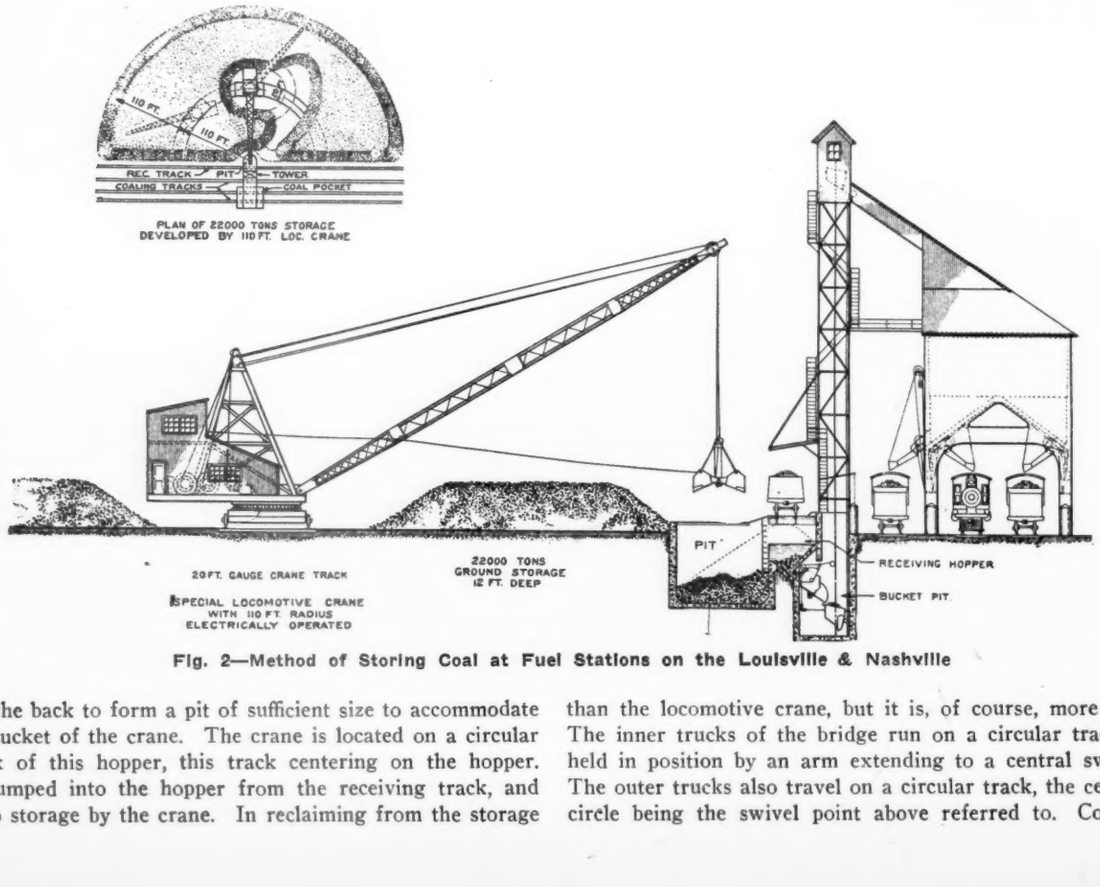


Fig. 2—Method of Storing Coal at Fuel Stations on the Louisville & Nashville

into the pit at the side of the receiving hopper of the coaling station, is picked up by the grab bucket on the bridge and placed in storage. A swivel bridge of latest design can be contracted for complete above the rails, for from $25,000 for 100 ft. span, up to $50,000 for 250 ft. span, and handling from 100 to 300 tons of coal per hour.

The cable and drag scraper method has been adopted by the Southern Railway, the Canadian Northern, and others. It is illustrated in Fig. 3. The storage pile is located directly back of the receiving hopper of the coaling station on a large elliptical area. The coal is dumped into the hopper and conveyed to the top of the coal pocket by the usual mechanical means. Instead, however, of dumping into the coal pocket, the coal is deflected into a chute which carries it out into the storage area. The coal is then spread over this area by means of a drag scraper operated from a drum in a tower over the hopper. Located at intervals around the storage area are pulling poles to which are attached snatch blocks for the endless cable. This method has the advantage of low first cost and low cost of operation, but causes a great degradation to the coal.

The cableway excavator method contemplates having the storage pile between the receiving hopper and the coal pocket, and is particularly well adapted to a storage of 2,000 or 3,000 tons. A mast is provided at the coal pocket of sufficient height to enable the drag bucket to dump into the bin. Directly behind the receiving hopper, anchorages are provided for the main cable. The hopper is so constructed that the drag bucket may scrape toward the coal bin over a sloping concrete floor. In reclaiming, the coal is picked up by the drag bucket, and deposited directly into the coal pocket, ready for locomotives. This is a very economical system, and has the advantage of not requiring additional machinery for the coaling station. It also lends itself very readily to "under-water" storage.

A central storage plant should provide for the storage of from 100,000 to 500,000 tons, and each plant should be as elastic as possible. It should be located at some convenient central distributing point. It should be as near permanent in its construction as possible, and be so designed and constructed that it could be protected at all times without much expense for maintenance, operation and care. It is believed that a modern plant, answering all practical purposes, can be installed for 100,000 tons of coal for an outlay of from $30,000 upward.

[The committee included in its report a description of the coal storage plants at the Panama Canal as representative of the latest practice, the matter being taken from the annual report of the Isthmian Canal Commission for the year ending June 30, 1914.—EDITOR.]

WEIGHING AND MEASURING DEVICES AT FUEL STATIONS

The committee recognizes the absolute necessity for having correct efficiency performance records of individual locomotives and enginemen, and believes that the railroads and their executives are prepared to spend certain moneys for proper auditing, but that they desire more reliable results and want to know the actual facts as to what their locomotives and enginemen are doing. Fuel accounting should be considered from two separate and distinct standpoints: That of value and that of quantity. The individual coal plant, locomotive and enginemen should be charged with that which it or he receives, and credited with that which it or he issues and uses. No adjustments of any character should be included in the published statements showing individual performances.

It is deemed advisable to suggest the adoption of some reliable automatic means of weighing and measuring, and devices that might be cheaply installed, operated and maintained; not only on new plants being installed, but also that might be applied to plants that are in operation. The committee suggests that this subject be again referred to them, believing that additional methods of establishing an automatic and reliable record of the actual amount of coal issued by each plant to each locomotive and each engineman will be on the market during the coming year.

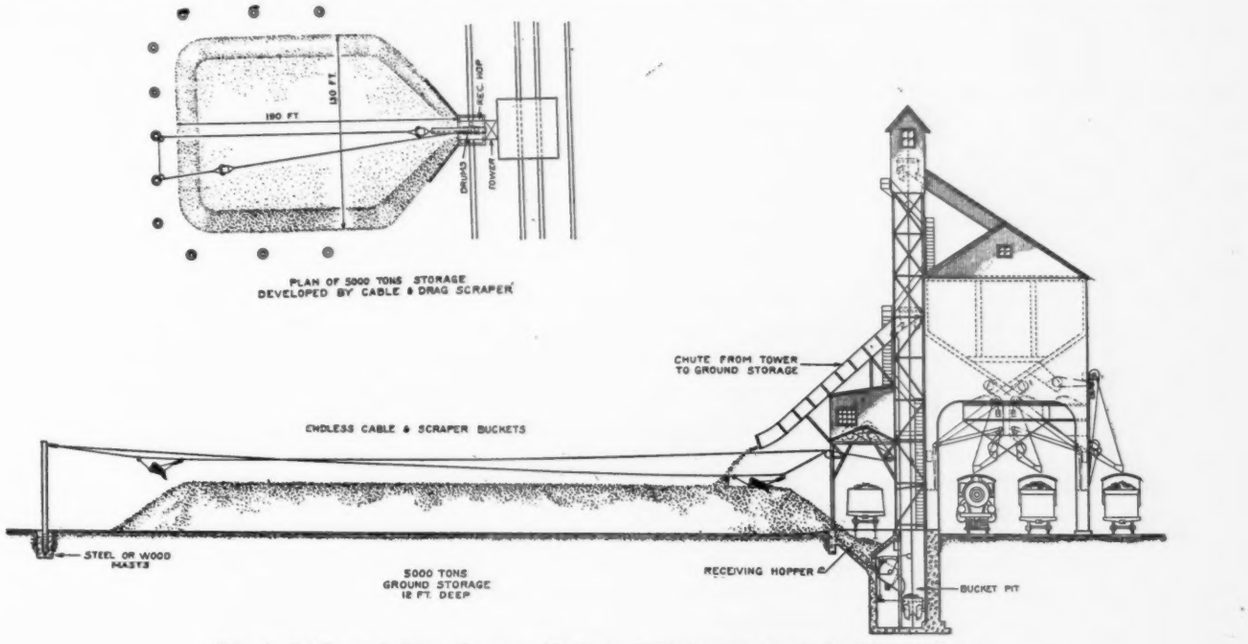


**Fig. 3—Cable and Drag Scraper Method of Storing Coal at Coaling Stations**

The report is signed by H. J. Slifer, chairman (Cons. Eng.); E. A. Averill (Standard Stoker Company); E. E. Barrett (Roberts & Schaefer Company); W. E. Dunham (C. & N. W.); H. B. Brown (I. C.); G. W. Freeland (Williams White & Co.); W. L. Krausch (C. B. & Q.); R. A. Ogle (Ogle Construction Company); D. J. Madden (Erie), and J. L. Rippey.

## MECHANICAL STOKERS

The mechanical stoker today is practical, operating at a mechanical firing efficiency of 90 per cent or more, and effects operating economies that cannot be otherwise obtained—it is no longer in the experimental stage. Improvements in the design and construction of stokers will no doubt be made for many years to come. Locomotive design will undoubtedly be modfied until the stoker becomes a part of the original design instead of being

merely an attachment to the locomotive, as at present. Notwithstanding the necessity for further improvements the fact can no longer be questioned that the mechanical stoker today is an important factor in railroad operation and must be recognized as such by all thoughtful railroad officials.

The real economy of the stoker is in the increased tonnage that can be handled by stoker-fired locomotives—not in the saving of fuel, as seems to be the general impression. The large, mechanically-fired locomotives of today are able to handle more tonnage than the same locomotives would be given if hand-fired, and handle this tonnage at a higher speed and with greater certainty than under hand-firing conditions. The development of the stoker has made possible the development of locomotives designed to burn coal continuously at a rate in excess of the capacity of the ordinary fireman to supply it. The real reason, therefore, for the improvement and adoption of the mechanical stoker is found in the economic necessity of reduced operating costs. The capacity of locomotives already in service may be increased and cheaper grades of fuel may be used on such locomotives, with the locomotive stoker.

According to the most reliable figures obtainable at the present time (April 1, 1915) and not including the experimental stokers, there are at the present time approximately 935 locomotives equipped with stokers on about twenty different lines of railroad.

There seems to be no fixed factor which can be used as a sure guide as to what constitutes a stoker job. One report indicates that any locomotive of 200,000 lb. total engine weight, with cylinders of 22 in. or over should be operated with stoker-firing. A second report states that engines having a tractive effort of 50,000 lb. or over should be stoker-fired. It seems to be the consensus of opinion that locomotives should be hand-fired when the coal consumption for extended periods does not exceed 4,000 lb. per hour.

The consensus of opinion is that the stoker will give about 10 per cent increased tonnage capacity, as compared with hand-firing, under the same conditions as to grade and time. Some believe that the tonnage increase will be more than 10 per cent. It should not be expected that stoker-firing will show any advantage in this respect where the job is within the capacity of a competent fireman. Stoker engines will make better time than hand-fired engines and while doing so will haul more tonnage than can be hauled with engines that are hand-fired.

It has not been the intention in the design of the Crawford stoker to use any cheaper grade of fuel than is used on similar engines that are hand-fired, nor does the Crawford stoker require the use of prepared coal. Both the Hanna Locomotive Stoker Company and the Locomotive Stoker Company state that their stokers will handle cheaper grades of fuel than can be successfully hand-fired, and that their stokers will enable locomotives to use some grades of coal that would be impossible with hand-firing. The Erie's experience does not indicate that a cheaper grade of fuel should be used.

The consensus of opinion seems to be that stoker-firing will not show a saving in the gross amount of fuel used, although there is a slight diversity of opinion on this subject. It is believed that there will be a saving on the basis of the amount of coal burned per thousand ton miles. This is due to the fact that additional tonnage is handled by stoker-fired engines with about the same gross amount of coal as with hand-fired engines. A marked saving is also made by the use of a less expensive quality of fuel.

While the stoker is a factor in increasing locomotive efficiency —that is, while it increases locomotive tonnage capacity to such an extent as to overbalance considerations as to first cost and maintenance costs—it is not a device for saving fuel. The real economy of the stoker is in the increased tonnage that can be handled. This is the meat of the whole stoker proposition. If increased capacity of locomotives is desired, then stokers are economical. If economical evaporation is what is required on large engines, its attainment may result in a sacrifice of maximum tonnage capacity.

Black smoke can be made with both hand and stoker-firing, or it can be eliminated by careful stoker or hand-firing. Average stoker-firing will probably show less black smoke than average hand-firing, because the coal is delivered to the fire in smaller quantities at a time.

There is less liability of engine failures with stoker-fired engines, owing to the fact that the stoker practically eliminates the necessity of opening the fire-door. Thus a more even temperature is maintained in the firebox, with less liability of leaky flues. In addition to this, if the engine should have leaky flues and bad grates or a bad fire, steam pressure can often be maintained with a stoker, when under hand-firing it would be impossible to keep up steam. Records to date indicate that firebox troubles are less on stoker-fired engines than on hand-fired engines.

The most important phase of the stoker proposition is that the engineer does not have to figure on the stoker tiring out, and is willing to work his engine to its full capacity under all conditions; whereas, under certain conditions with hand-firing, it would not be expected that the fireman could stand up against the largest engines when they were worked to full capacity. It is for this reason that increased tonnage can be handled with a stoker-fired engine, closer meets can be figured on and made, and better general results obtained.

The first cost of stoker installation, giving approximate figures only, is somewhere between $1,500 and $1,700. Maintenance costs, including interest on the original investment, are anywhere from ½ cent to 1 cent per mile. Maintenance cost figures at the present time, however, are not particularly reliable on account of the fact that more or less experimental work is being done with these stokers. It is generally stated that stoker maintenance costs do not nullify the saving in fuel cost possible where the stoker uses a cheaper grade of fuel. The only figures that have been presented on the cost of lubricating the stoker show the cost to be about $1 per 1,000 locomotive miles.

There is no added probability of engine failures which are not stoker failures on stoker-fired engines; and the reverse seems to be the case, on account of reduced liability of boiler failures. The consensus of opinion seems to be that a stoker failure should not imply even a partial engine failure, although the instructions on some roads are that in case of a complete stoker failure, tonnage will be reduced to hand-firing rating. One road reports that a stoker failure means a complete engine failure, on account of the fact that such a low grade of fuel is used on stoker-fired engines that hand-firing cannot be successfully performed with this fuel.

A skilled fireman must be employed on stoker engines, owing to the fact that it is occasionally necessary to resort to hand-firing for short distances, and to the fact that in the case of a partial, or complete stoker failure, hand-firing is necessary. The stoker makes the fireman's job a better one. He makes more money, on account of being able to follow his engine more closely, and a large percentage of the manual labor necessary with hand-firing is eliminated. Any good fireman can easily learn to operate a stoker. A fire which is properly prepared for hand-firing is all right for stoker-firing.

There should be no reason for a failure of the stoker equipment holding an engine beyond the ordinary time required for turning. In fact there are no repair jobs on a stoker that would necessitate delay, providing a proper stock of repair parts is kept on hand and the work handled promptly.

The Pennsylvania record with the Crawford stoker, covering a total of 204,922 trips, including all of the experimental trips during the time the stoker was being developed, shows an efficiency of 83.8 per cent. It can be readily understood that present efficiency is considerably higher than this figure. A six months' record of the use of stokers on the Norfolk & Western shows 97½ per cent efficiency, which makes the statement that the

stoker is over 90 per cent efficient at the present time seem conservative. Roads having a considerable number of stokers in service show a performance of over 50,000 miles per engine failure on stoker-fired locomotives.

It seems conservative to state that the stoker will show a very satisfactory fuel economy based on ton-mile performance. That is, while it may not show a reduction in the gross amount of coal consumed per trip, it will show that it can haul more tonnage than a hand-fired engine, using about the same gross quantity of the same or a cheaper grade of fuel.

From the coal producers' standpoint, the increased demand for slack coal and screenings for stoker-fired engines will no doubt be of benefit.

The stoker permits general operating efficiencies that would be otherwise impossible. Trainloads can be increased by the application of stokers to locomotives where the cost of grade reduction would be prohibitive or where bridge weights or terminal facilities, or both, might prohibit the introduction of heavier and larger power. On districts where train movement is so frequent as to approach the limit of single or double track capacity the increased speed of trains hauled by stoker-fired locomotives, together with the increased tonnage of such trains, will assist in relieving the congested conditions.

The stoker entirely obviates any question of the necessity for two firemen on large engines.

The stoker lives up to its worth, maintaining maximum steam pressure uniformly when the engine is worked at 100 per cent cut-off or at shorter cut-offs and higher speeds. To sum it all up, the stoker, even in its present state of development, pays and pays well in every case where a real stoker job is indicated.

The development of the stoker makes the design of larger locomotives possible and practicable. In fact, locomotives have been purchased within the last two years and are being built today which would neither have been purchased nor built had it been necessary to have them hand-fired. This refers particularly to the very large Santa Fe type, Mallet and Triplex engines.

In closing this report the committee begs leave to call the attention of this association to the fact that the stoker has arrived. It is a success, and, furthermore, it is an absolute necessity from an economical operating standpoint for a great number of the large engines of the present day.

The report is signed by: D. C. Buell (U. P.); W. C. Hayes (Erie); A. N. Willsie (C. B. & Q.); T. R. Cook (Penn.); R. Emerson (S. L. & S. F.); O. L. Lindrew (Ill. Cent.); L. R. Pyle (M. St. P. & S. S. M.); Edw. C. Schmidt (Uni. of Ill.), and C. A. Spaulding (C. & N. W.).

### DISCUSSION

It was the general opinion that in the consideration of the locomotive stoker the fuel economy should be considered secondary to the operating advantages this device presents; that is to say, its ability to increase greatly the boiler capacity and thereby permit of greater tonnage to be handled at higher speeds would outweigh the increased amount of fuel that the stoker consumed. In addition to this, a much cheaper grade of fuel can be used successfully than is possible in hand-firing. However, tests comparing the stoker with hand-firing have in some instances shown an increase in evaporation.

E. A. Averill, of the Standard Stoker Company, called attention to comparative tests made on the Pennsylvania division of the New York Central with the Standard stoker. In one set of these tests the conditions were maintained as nearly alike as possible, five hand-fired runs and four stoker-fired runs being made with the same engine, the same engine crew and practically the same tonnage. A poorer grade of fuel, however, was used on the stoker-fired engines, averaging 13,711 B. t. u. for the stoker runs, as against 14,494 B. t. u. for the hand-fired runs.

"These tests," Mr. Averill said, "indicate clearly the following: First, the locomotive when stoker-fired evaporated 7.4 per cent more water per unit of heat supplied; second, 18.6 per cent more coal of 5.4 per cent lower heat value was burned per square foot of grate area per hour by the stoker, resulting in the generation of 18.8 per cent more steam; third, while the power in the cylinder was increased 20.2 per cent, if gaged by the amount of steam consumed, the amount of dry coal used for the stoker increased but 15.9 per cent, and was 5.4 per cent lower heat value."

Another stoker-fired test of one run was made with an increase in tonnage, which compared with five hand-fired tests, as follows:

| | Hand fired | Stoker fired | Per cent difference |
|---|---|---|---|
| Actual tonnage | 3,786 | 4,218 | 11.2 |
| Adjusted tonnage | 3,563 | 3,995 | 12.1 |
| Running time, in hours | 3.74 | 3.38 | 10.7 |
| Average speed, miles per hour | 16.12 | 17.8 | 10.4 |
| Average boiler pressure, lb. | 195.3 | 201 | 2.9 |
| Total coal fired, pounds | 18,640 | 21,000 | 12.67 |
| Dry coal fired, pounds | 18,426 | 20,676 | 12.2 |
| Dry coal, per hour | 4,924 | 6,117 | 24.2 |
| B. t. u. per pound of coal | 14,494 | 13,767 | 5.3 |
| Total water to boiler, pounds | 116,624 | 137,915 | 18.3 |
| Steam used in cylinders per hr. | 29,734 | 39,295 | 35.5 |
| Pounds of water per million B. t. u. in dry coal | 436.8 | 484.6 | 11 |
| Cost of coal per million B. t. u. in available steam | .0624 | .0575 | 8.5 |

These tests indicate: First, the locomotive when stoker-fired, pulled 12.1 per cent greater tonnage at 10.4 per cent greater speed, with an increase of but 12.2 per cent in dry coal, which was of 5.3 per cent lower heat value; second, when stoker-fired the boiler evaporated 11 per cent more water per unit of heat supplied; third, the power as judged by the amount of steam consumed by the cylinders per hour, increased 35.5 per cent, while the dry coal per hour increased but 24.2 per cent and was of 5.3 per cent lower heat value on the stoker-fired run; fourth, the cost of coal per million heat units in available steam was decreased 8.5 per cent by the stoker.

H. B. MacFarland, Sante Fe, stated that he had also found that the stoker engines have shown an increase in evaporation over hand-fired engines.

On the Duluth, Missabe & Northern the stoker engine uses coal that passes through a 2-in. bar screen, the lump not passing through this screen being used for hand-fired engines, thus giving a much better grade of coal for that service. While the fine coal is desirable, it is not impossible to use the larger coal. The Chicago, Indianapolis & Louisville find it expedient to use coal from which the screenings passing through a 4-in. screen have been removed, this being done to accommodate the mine operator. No trouble has been experienced with handling this kind of fuel. Mr. Willsie, however, recommended that screenings pass through a 2-in. round hole screen, which gives the best results. F. Kirby, of the Baltimore & Ohio, stated that a mixture of nut, pea and slack gas coal for stoker engines will give a saving of about 10 per cent over other classes of coal. Trouble has not been experienced when this grade of coal is used for one part of the run and run-of-mine for the next, thus showing the adaptability of the stoker to the various grades. Mr. Kirby believes that better results could be obtained if more attention was given to the draft appliances. On the B. & O. the stoker-fired Mikado engines use from 6 to 6¼-in. nozzles. The 2-10-2 type engines use 6½-in. nozzles, and the Mallet engines used 6¾-in. nozzles.

W. S. Bartholomew, president of the Locomotive Stoker Company, sketched the development of the stoker briefly and stated that this device did not generally find a market until the engines got so large that it was necessary to mechanically fire them in order to obtain their rated boiler capacity. The problem for the stoker manufacturers now is to develop the stoker for the economical use of fuel. Most any kind of coal can be used, and from the mechanical standpoint the stoker is a success. Regarding the use of pulverized fuel, he believed that there was a distinct field for that and the stoker, as the stoker eliminated the necessity of pulverizing the fuel, which must be done at more or less expense, and that many of the advantages claimed for the

pulverized fuel are now being obtained on stoker-fired engines. He also strongly favored the use of the brick arch on stoker locomotives, but pointed to the fact that inasmuch as they presented economies in themselves their acquisition and maintenance should not be charged to the stoker.

The overfeed stoker was criticized to some extent on account of the fact that with the intense draft of the locomotive and the fineness of the coal used, a large amount of the fuel would pass out of the stack unconsumed, thus materially reducing the fuel economy. The smoke question was also believed to be a serious one with the overfeed type of stoker, but the defenders of this device blamed the occurrence of these features to the lack of the proper design of brick arch and improper instructions and supervision to the fireman. Both the smoke and the escape of steam from the pops should be more carefully watched if fuel economy is to be obtained in stoker engines. It has been found that new men are best on the stoker engines, as they can be more properly educated. As with any other device, the stoker must be properly maintained, and the cost of not doing this will be reflected in the fuel performance of the engine.

## FUEL OIL FOR LOCOMOTIVE USE

BY G. M. BEAN
Pacific Coast Representative, American Arch Company, Los Angeles, Cal.

From 1907 to 1914 the use of fuel oil by railroads increased 112 per cent, and until a total of 31,000 miles, distributed over 50 railways, was operated with this fuel. A study of the use of fuel oil in the locomotive furnace is extremely interesting.

In the combustion of fuel oil, where the steam spray is used for vaporization, we are confronted with the fact that in the process of atomization we start the particles of oil on their way to the flues, even before they are partly burned. The first result of these particles coming into the heated portion of the furnace is to separate the carbon from the hydrogen, the carbon thus being left as a fine dust floating in the furnace in such a manner as to be easily carried to the flues unconsumed, to be deposited as an insulating layer of soot, or to be carried out of the stack in the form of black smoke. If these fine particles of carbon were attached, as in a bed of coals, a supply of air could easily complete their combustion. With liquid fuel, therefore, the diffusion must be simultaneous with ignition, with the resultant long flame. Large furnace volume is very essential to the burning of fuel oil. While the relative dimensions are of minor import to the volume, it is evident that we must provide a flame passage of sufficient length to prevent unconsumed particles passing to the flues.

There are two distinct types of oil burners, namely, the external atomizer and the internal atomizer. The former has by far the most general use, both in stationary and locomotive practice. The burner of this type used on locomotives consists of a rectangular casting containing two longitudinal passages separated from each other by a horizontal partition. The oil flows through the upper passage to an opening in the face of the burner so arranged that it allows the oil to drool down on to the flat steam jet which issues from a similar but much smaller opening. The steam sprays the oil into fine particles and forces it back to the point of combustion or to the vicinity of the flash wall.

All of the burners use steam at full boiler pressure as the atomization agent. Experiments with the use of air and superheated steam have been conducted, but no results obtained which were considered of sufficient importance to warrant their use. However, the writer believes that further experiments in the use of superheated steam are advisable, in view of the fact that it is extensively used in stationary and marine service.

At the first inception of the idea in this country it was natural that the designs used in Russia were followed. The burner was placed under the rear of the firebox, and directed forward with an upward incline so that the flame shot under a low, short brick arch, with the result that combustion became so intense in this limited space as to cause the flame to pass from under the arch with such velocity as to impinge on the door sheet, side sheets and crown sheet, with very detrimental results. The back end burner arrangement also required an excessive quantity of fire brick, which not only gave trouble by continually burning out, but also served to cover up valuable heating surface, restrict the furnace volume, and throw an increased load on the remaining heating surface.

The burner is now placed in the front end of the draft pan (Fig. 1), and directed toward the rear in such a manner that the draft is forced to reverse the direction of the flame before it passes to the flues. The furnace is open, the brick work kept low and the maximum of heating surface exposed. The correct drafting of this arrangement is still a somewhat debatable subject, but the general idea seems to favor the admission of the principal volume of air through openings in the vicinity of the flush wall, which is built up under the door, it being the plan to admit this air through numerous small openings, preferably circular in shape, and distributed well over the rear third of the draft pan in such a manner that the air is brought in contact with the flame from several directions and not in too concentrated a volume. A small amount of air is also admitted around or under the burner so as to prevent it from overheating, and keep the flame from dragging on the floor of the pan. This

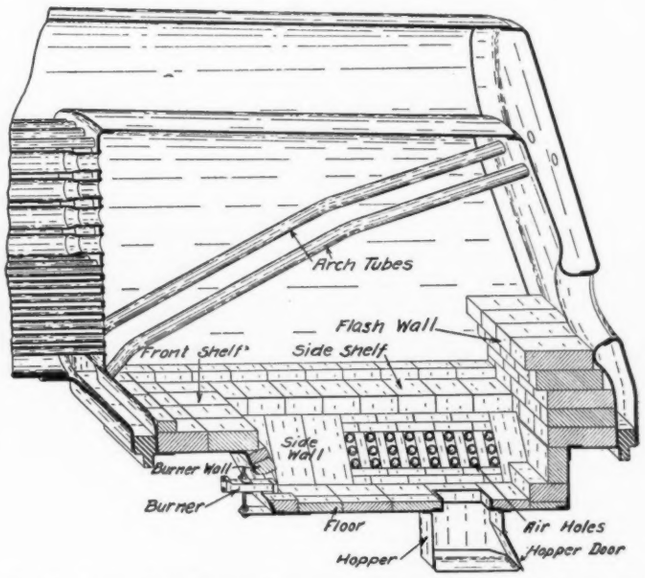


Fig. 1—Front End Burner Furnace, Atchison, Topeka & Santa Fe

arrangement results in a very uniform distribution of heat and the consequent lengthened life of the fireboxes and flues, until now it can safely be said that for service under like conditions, a firebox on a locomotive burning oil will last longer than one in a coal burner if consideration is given to the extra work possible to be obtained from the oil burner. Oil requires from 20 to 30 per cent more air per pound of fuel than the average bituminous coal. There is a tendency to restrict the air openings in draft pans of oil burners, and the writer has found it very generally the rule that with locomotives of the same class in both oil and coal burner service the oil burner will have the smaller nozzle, indicating the necessity for maintaining a higher front end vacuum in order to draw in the necessary amount of air to make the engine steam properly. This is attended with the added difficulty that the high velocity of the entering air produces a more concentrated column or stream which is difficult to break up, requiring a heavy atomizer, the use of which has its disadvantages.

The oil supply is carried in tanks built to fill the coal space of the tender, and piped from there through suitable connec-

tions to the burner. It is generally necessary to provide means for heating the oil so as to insure a proper flow, as gravity is depended upon for the necessary pressure. It is probable that the box heater is the most desirable arrangement, and it will be seen by referring to Fig. 2 that it is indirect in its action, only heats a sufficient volume to insure a supply at the burner, and is not liable to cause trouble by allowing water to get into the oil storage.

Fig. 2 shows in detail the general arrangement of oil burner equipment which represents the latest standard arrangement as applied to locomotives of the Atchison, Topeka & Santa Fe, and is probably as complete and efficient as any so far devised. In an experimental way arches are being applied on the tubes shown and it is anticipated that an improvement in furnace efficiency, life of flues, etc., will be the result. The carrying of arches in this manner has been successfully followed on the New York Central lines for some time, and the practice will undoubtedly be extended throughout all oil-burning equipment.

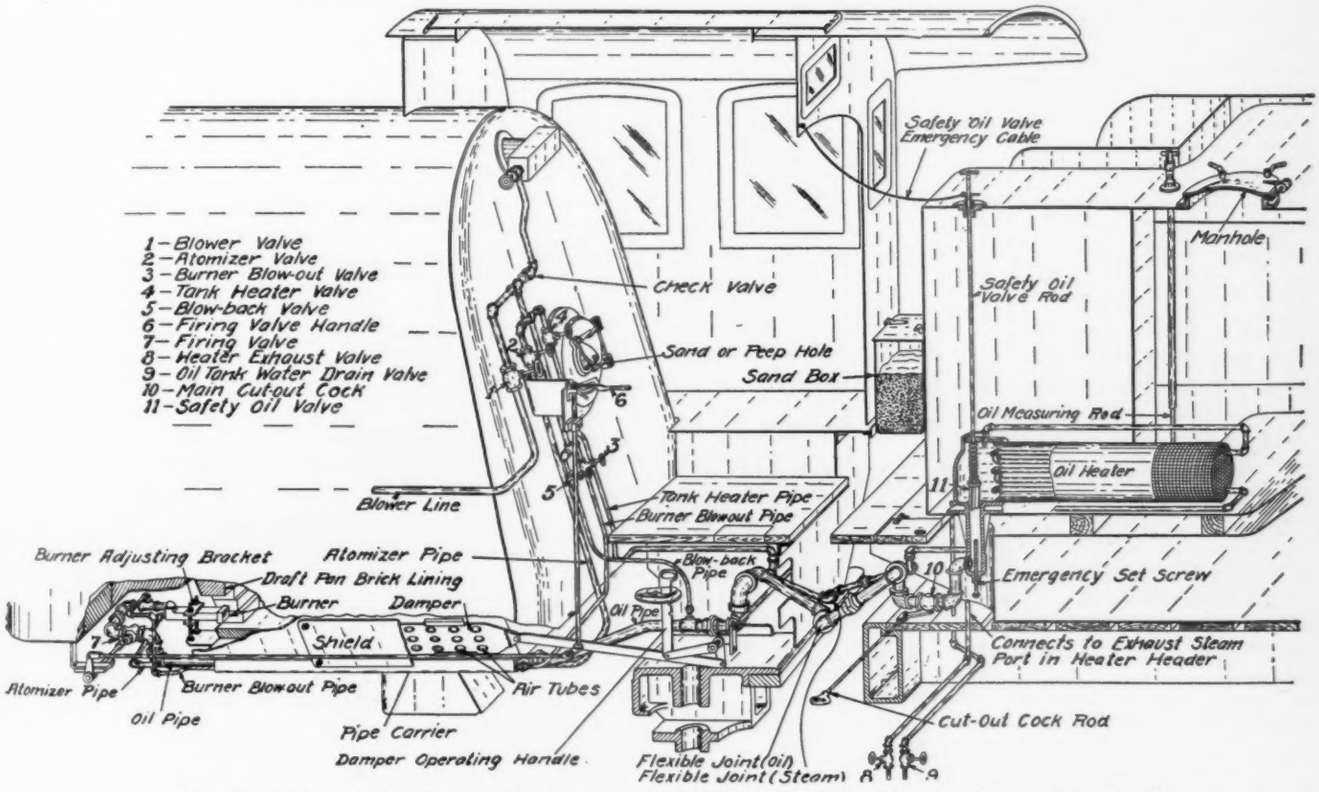


**Fig. 2—Standard Arrangement of Oil Burning Apparatus Used on the Atchison, Topeka & Santa Fe**

Special attention is called to the necessity for careful supervision of all locomotive equipment and care not to abuse the privilege of having oil burner power to handle trains by overloading at the ultimate expense of the fireboxes and flues. Emphasis should be placed on the fact that the oil fireman is a large factor in the success of the operation of oil-burning locomotives. He must intelligently follow every movement of the engineer that demands regulation of the fire. He has two gages to guide him, the top of the stack and the steam gage. That is, the proper steam pressure must be maintained with the least possible smoke. A thin gray color at the top of the stack is usually indicative of proper combustion.

DISCUSSION

Several members spoke in favor of the brick arch for oil-burning locomotives, as with this device the flame is more equally distributed throughout the firebox and the flues are protected from the cold air. However, the arch must be maintained in good condition and care must be exercised in draining the boilers, as the brick work stores up such a large amount of heat that overheating will occur if the brick work is not allowed to cool down before the water is removed from the boiler. There is a tendency on account of the ease of operation of the oil-burning engines, to neglect their maintenance. This should be carefully watched and not allowed, as it will not only give a poor performance in oil consumption but cost more than if the engines were properly maintained between the general shoppings.

H. T. Bentley, of the Chicago & North Western, stated that there are 124 oil engines on that road, and he finds that the cost of repairs to them is not more than for the coal burners. When the oil burners get in bad condition it has been found possible to get more life out of the boiler and out of the engine between shoppings by changing them over to coal burners.

The size of the burner should not be too large, the tendency being to have them so. The large 2-10-10-2 Mallet locomotive, No. 3,000, on the Santa Fe, is operated with only one 3-in. burner. The engineer and fireman should co-operate, and the fireman anticipate the engineer's operation of the throttle with his control of the oil. The success of the oil burner depends upon the fireman, and he should be properly educated and supervised.

## FRONT ENDS, GRATES AND ASH PANS

The committee on this subject sent out letters of inquiry to various railroads requesting information concerning the front end, grate and ash pan arrangements.

*Front Ends.*—Ninety individual arrangements were submitted for non-superheater locomotives, and they show a wide variation in the arrangement of the drafting appliances, there being no well-defined prevalence of any given arrangement, nor a general conforming to the master mechanic's recommendation for the proportioning of the front end. Thirty-eight individual front end arrangements were submitted for superheater locomotives showing the practice on 14 roads. These prints show a general prevalence of arrangement using a short nozzle stand and an inside stack with a wide flare at the base, and a considerable overdraft. During the past one or two years particular attention

has been directed toward the form of the exhaust nozzle. The drafting of locomotives has always been considered a function of the front end alone, but speaking broadly, this is not correct. Drafting may be defined as the controlling factor in combustion of the fuel, and rightly starts at the air openings in the ash pan. With these fixed the grate next governs, and then the firebox volume, tube area and length, the brick arch, etc., all exercise influence over the problem. If these items are right it is not believed that any very delicate adjustment in the smoke box will be needed. There is nothing mysterious about the action of the exhaust jet to induce draft, and if all other factors receive their just due, it is not believed that we would have engines of the same class varying ½ in. in the diameters of their nozzles, with their diaphragms clear down or clear up, etc.

*Grates.*—Twenty-one railroads responded to the request for design of grates. From a study of the replies it is found that the percentage of air openings of 62 bituminous grates varies between a minimum of 25.8 per cent in one design of interlocking finger grate type and a maximum of 49.6 in a design of the herringbone type, the average of all cases giving a percentage of 37.2 per cent. The degrees of coarseness of the grates have been expressed in terms of the maximum dimensions of any air openings. This figure will vary between the limits of ½ in and 1½ in. The 1 in. dimension of air opening is found to be that most generally used. The character and the degree of fineness of the coal appears to govern the degree of coarseness of the grate to be used. The nature of the coal and the degree of tendency to form a clinkery ash will naturally govern the design in that particular in reference to the width of grate bars or length of the fingers.

*Anthracite Grates.*—The percentage of air opening for the anthracite grates received varies from 32 per cent to 46.9 per cent, the average being 39.4 per cent. The coarseness of the grate in these cases, as represented by a maximum air opening, is ⅜ in. in two cases and ½ in. in the other.

*Ash Pans.*—From the information received it is evident that there is a very great variation in this important point at the present time. The highest percentage of air opening in regard to grate area for bituminous coal is 15.1 per cent, while the least is 5.78 per cent, a difference of 161 per cent. With the tube area taken as a basis of comparison the maximum is 127.1 per cent and the minimum 50.8 per cent, the difference in this case being 150 per cent. The average ash pan air opening for all bituminous burning engines is 11.08 per cent of the grate area and 82.1 per cent of the tube area. Previous investigations have shown that the air openings should total not less than 14 per cent of the grate area for best all around results, and from the information collected it would seem that not less than 110 per cent, instead of 75 per cent, of the tube openings should be used for the air opening in the ash pan. It is difficult to conceive any valid argument either from a theoretical or a practical standpoint against ample air openings under the fire. With restricted areas the velocity of the air must be increased, necessitating high draft throughout the system. Conversely ample areas will allow a reduction in the total draft.

It has been determined that the angle of repose of ash under the conditions encountered in locomotive service is in the vicinity of 53 deg. from the horizontal. The ash pan volume should be made as large as possible, this being a safe rule, as with modern power they can hardly be made too large. On very large power with trailing wheels the use of the six hopper style of pans will often very materially increase the capacity over what might else be obtained. A proper guard against throwing the fire from the ash pan air openings must be provided. It is believed that the best method is that of admitting air for the full length of the mud-ring and protecting the opening by rolling up the outer edge of the top of the ash pan high enough to make it impossible for the emission of fire. When netting or perforated plate guards are used it is difficult to keep them in first class condition, as they must generally be hinged and they are apt to become warped or bent, making it impossible to close them fire tight. They also cut down the air opening very considerably and cases have been known where they have been painted over so often as to practically stop up the holes, restricting the air flow very seriously.

The report was presented by M. C. M. Hatch, chairman of the committee on Drafting Locomotives.

### DISCUSSION

A. G. Kinyon, of the Seaboard Air Line, spoke strongly in favor of the table grate, as it provides a much greater air opening and will better distribute the air through the fire.

Some success has been obtained by the use of the double-exhaust, the Delaware, Lackawanna & Western having made it standard on all their anthracite burning locomotives and are now trying it on the bituminous coal engines. While as a rule success has not been obtained with the variable nozzle, one design was mentioned as being successful. The nozzle has a bridge that may be raised or lowered from the cab, thus regulating the area of the nozzle opening.

### OTHER BUSINESS

The committee on Storage of Coal presented a very interesting and instructive report, showing that the storage of coal is desirable from two points of view. It will not only assist the coal operators, which the railroads should be very willing to do, and it is also of advantage to those roads which find it necessary to haul the coal long distances or find it difficult to procure their coal exactly when they want it. By the storage of coal at the proper time the coal carrying equipment will not only be released for carrying revenue coal at the rush periods, but there will also be a much less amount of equipment necessary. A large percentage of the coal carrying equipment now in service on the road is only in active operation for a few months of the year. Thus it is seen that a large amount of capital is tied up in a non-productive state for a very large period of time. Much could be done to relieve this situation if the railroads could be induced to store their coal.

An interesting method of examining storage piles for undue heat was mentioned during the discussion. This may be done by means of an iron rod 2½ in. in diameter, which is worked down to the bottom of the pile and allowed to remain there for 12 hours or more. On withdrawal, if it is too hot the storage pile at that point should receive immediate attention. The critical temperature, as ascertained by those in authority, is believed to be 140 deg. Fahr. In the storage of coal a concrete floor will be found desirable, and care should be taken that there are no pockets in this floor, for they will accumulate moisture. The height of the storage piles will vary according to the characteristics of the coal and the storage ground upon which it is placed. Many instances were mentioned where coal had been stored for 2 to 10 years with no trouble from spontaneous combustion, while new coal would take fire quite readily.

The committees on Fuel Tests and Fuel Accounting submitted reports of progress. Arrangements have been made with the University of Illinois to conduct tests on various classes of fuel, as soon as the necessary contributions can be obtained for conducting this work. The committee on Fuel Accounting reported that it is to seek to reduce the number of forms in order to eliminate the clerical expense of the work. Other papers were presented on Fuel Conditions in South America by James W. Hardy and the Waste of Fuel in Railway Stationary Plants by Jos. W. Hays. Mr. Hays called attention to the very poor conditions found in railway stationary boiler plants and pointed to the large economies that might be made if this matter was given the proper attention. His paper was presented by F. A. Moreland, who showed lantern slides of the actual conditions found in service. The remarks of both these gentlemen were more or less confirmed by S. H. Viall, chief deputy smoke inspector of the city of Chicago, who mentioned a number of instances where the lack of proper maintenance of the boiler

setting and the draft appliances had been costing the railroads a large amount of money. In one case where a steam jet was placed in the stack to improve the draft at an expense of $10,000 for steam, the boiler setting and draft appliances were corrected for $5,000. Other items were mentioned of similar extravagance which occurred simply because proper supervision had not been given to this class of work. On the Wabash Railroad the locomotive supervisors have included in their duties the inspection of the stationary plants, and it has been found that they are able to very much improve their conditions by this practice.

A. W. Perley, Oregon-Washington Railroad & Navigation Company, made a very interesting talk on the possibilities the railway employes have in assisting the railways as a whole in the matter of adverse legislation. The following officers were elected for the ensuing year: President, D. C. Buell, Union Pacific; vice-presidents, John G. Crawford, Chicago, Burlington & Quincy; E. W. Pratt, Chicago & North Western; W. A. Averill, Baltimore & Ohio; executive committee, W. C. Hayes, Erie Railroad; H. T. Brown, Illinois Central; M. C. M. Hatch, Delaware, Lackawanna & Western; A. G. Kinyon, Seaboard Air Line, and T. J. Lowe, Canadian Northern. Chicago was chosen as the next place of meeting.

The secretary-treasurer reported a total membership of 680 and a cash balance of $826.62; 316 members registered during the convention.

## THE MECHANICAL SIDE OF RAILROADING*

BY WILLIAM SCHLAFGE
General Mechanical Superintendent, Erie Railroad

If we are to analyze railroad operation it is obvious that we will find that each department has problems and troubles peculiar to itself. On the mechanical side the great problem, as to American railroads, is the care, inspection and maintenance of 2,500,000 freight cars, 56,000 passenger train cars and 66,000 locomotives, representing an investment estimated at three billion three hundred and fifty million dollars and calling for an annual maintenance charge estimated at $450,000,000. It is not possible, nor even desirable, perhaps, to go into the details of mechanical operation to show the magnitude of the work involved; but a faint conception of it can be had by recalling that approximately one billion passengers and over one billion tons of revenue freight are carried per annum on American railroads. Carrying units must be kept in condition to transport this great volume of business in safety, to conserve both life and property, and locomotives must be maintained in condition to move it.

To meet the complex responsibilities of the mechanical side of railroad operation and maintain the equipment in a state of preparedness demands, as in every other department of the business, a balanced and efficient organization, whose members shall be devoted to the work and sustained by the animated pursuit of a common purpose. The usual staff organization of the mechanical department consists of a chief officer, styled superintendent or general superintendent of motive power, mechanical or general mechanical superintendent, superintendent of machinery, or other title appropriate to the office. On the larger roads the chief mechanical officer, as a rule, is assisted by one or more deputies, bearing various titles, who have general authority and, sometimes, have direct supervision over the shops, thus standing between the shop organizations and the chief of the department. Not infrequently there is an officer charged with responsibility for the work of the car department, with the title of superintendent of car department, or master car builder. On the Erie Railroad there are three mechanical superintendents. One has general charge of all car work of the system, and one is assigned to each grand division of the road in direct charge of the locomotive shops and has concurrent jurisdiction, in a restricted sense, over car work in his territory. The other regular staff officers are a mechanical engineer, electrical engineer, engineer of tests, chemist, chief boiler inspector and general inspectors of various grades and diverse duties. The larger roads add to these two general officers who are indispensable where there is any pretense of practicing the higher phases of railroad economy, using that term in its scientific sense. These are an efficiency engineer, who is in charge of shop costs and production and frequently is at the head of the piece work system, and an expert in locomotive economy, whose duty it is to save fuel and look after the economical operation of the locomotive. On the Erie these officers are designated, respectively, as superintendent of piece work and apprentices, and superintendent of locomotive operation.

The chief officer of the shop organization is the division master mechanic, or shop superintendent, on the locomotive side and a shop superintendent, foreman of car repairs, or an officer having some similar suitable title, at the car shops. The division master mechanic frequently has charge of all mechanical work on his division; but it is customary to have large car shops entirely independent of his authority. The shop organization varies with the size and importance of the shop. At a large shop there are usually a general foreman, an assistant to the general foreman who is in charge of shop costs and production, departmental foreman, inspectors, etc.

In the division mechanical organization special mention should be made of the engine terminal which, by reason of its functions, is not properly classified with shop operations, whether closely associated with them or not. Nothing will paralyze traffic movement and demoralize operation quite as effectively as putting an engine terminal out of business, or to have it in charge of a man who is incapable of facing all emergencies and overcoming everything but the physically impossible. This is so well understood that we are accustomed to say that engine house foremen, like poets, are born, not made.

Associated with the divisional organization are the road foremen of engines and the inspectors of locomotive service, called supervisors of locomotive operation on the Erie. The mechanical department has concurrent jurisdiction with the transportation department over these officers.

A strong organization is essential to good operation; but there are limits to what may be done by the best organization and the most devoted and diligent application on the part of the personnel. A good organization may overcome, in a measure, the handicap of inferior, inadequate or obsolete shop and engine house facilities, but it can never supply their lack.

The mechanical side of railroading produces no income, sends no actual cash into the treasury regardless of what it may keep from going out. Its mission is to do its part to keep cars and locomotives in shape to earn revenue. Each passenger locomotive may earn approximately $3,700, and each freight locomotive $52,000 per annum, but the sad truth ever confronts the mechanical man, that from 20 to 25 per cent of all operating expenses is laid up against him. He is a good spender and he is always "broke." His stories, therefore, are apt to be of the hard luck variety. The mechanical man makes up a modest program for a new roundhouse at one point; two or three modern coal and ash handling plants; a couple of new power plants; perhaps a new shop; a hundred new machines and a job lot of fifty thousand dollars' worth of small tools and miscellaneous things regarded as useful in his business. When the hard pressed management makes a few minor revisions of his plans he cheerfully accepts the allowance, builds an extension to several stalls of the old roundhouse to house the big engines, puts new flues in the boilers of the much slandered power plants, gives the old shop a coat of whitewash inside, forgets the rest and, like a true railroad man, settles down to do business with what he has, as better men have done before him and will do after he has gone. After all,

*From a paper read before the Railroad Men's Improvement Society, New York, November 19, 1914.

he reasons, there is something to be thankful for. If something had to be cut off, far better the improvements than his head.

An ancient institution that has given way to enlightenment is the old railroad apprentice system. In the old days, the average apprentice who served his time in a railroad shop learned to operate the various machines and to repair locomotives, but he was rarely an all around mechanic. Little, if any, attention was given to his educational qualifications when he was apprenticed and, unless he had the ambition to attend night school or apply himself to study, he usually lacked that knowledge of the principles of mechanics and of higher mathematics which would fit him to extend his field of usefulness. Also the master was not particular, at all times, to concern himself about giving the novice the best opportunity to become a good all around journeyman. If the apprentice had special aptitude for certain work he was too frequently kept at it, instead of moving him about to afford a wider range of training. Moreover, certain details, like valve setting, air pump, lubricator, injector and tool room work were regarded somewhat in the light of trade secrets and the apprentice was fortunate who got any experience in or knowledge of this work. Progressive thinkers finally came to the realization that the system was all wrong and that it was not beneficial to the master, the apprentice or to society, and out of these conclusions has grown a system of railroad apprenticeship and industrial education of the highest type.

Speaking of the apprentice course of the Erie as typical, I can say that the railroad apprentice today has every opportunity to become a well rounded mechanic, and is given a basic technical education that equips him for the widest usefulness. In most cases the instructors are college graduates. Contrary to the practice under the old system, the apprentice is now carefully and fully instructed in the very things that, formerly, were withheld from him, and extreme care is taken to make him proficient in every detail of the art. Not only is the course free but the apprentice is paid for his time while under instruction.

But I would not have you get the impression that I am speaking as a mechanical man. Rather would I have you think of me as a railroad man. I have scant tolerance for departmental distinctions. Departmental lines are very proper, and necessary to fix the lines of responsibility and for the orderly and effective conduct of business; but no further. It is trite to say that all energies that are not directed toward the ultimate and legitimate ends of any business, are wasted or at least impaired. That end in the railroad business is to sell transportation at a decent profit, and everything which diverts energy, that the business is taxed to create, from that object is a thing to be weeded out. Those who accustom themselves to see departmental work in capital letters, failing to co-ordinate their relations with the general interests of the business, are in danger of acquiring a wrong perspective. We all preach about co-operation, but constructive evidence of its practice does not equal the noise we make about it. The word co-operation, like efficiency and other mouth-filling terms, is rattled about like a pebble in a tin can. Many know what constructive team work is, a few practice it, but the majority merely talk about it and look wise.

## INSPECTION OF LOCOMOTIVES AND TENDERS

At a meeting of mechanical representatives from over 50 roads with the Conference Committee of Mechanical Officers of the Special Committee on Relations of Railway Operation to Legislation, held at Chicago on May 24 and 25, the following rules were formulated for the inspection of locomotives and tenders. They were distributed to the railroads by the Special Committee as Bulletin No. 68, with the recommendation that they be filed by each railroad subject to the act, with the chief inspector of locomotive boilers at Washington, D. C., on or before June 4, 1915, and that in addition each road file at the same time its standard practice or practices with regard to tire thickness as contemplated under Rule No. 2.

### Rules for the Inspection of Locomotives and Tenders

1. Locomotives and tenders after arrival shall be inspected to determine that machinery and running gear is in safe condition. All repairs essential to safety shall be made before locomotive is returned to service. Locomotives with following defects will not be allowed to leave terminals where repairs can be made:

2. Wheels which do not conform to the limit of tread and flange wear recommended by the American Railway Master Mechanics' and Master Car Builders' Associations shall be removed or handled in accordance with the standard practice of each railroad involved, except as follows:

3. Steel wheels and steel tires with following defects will not be allowed to remain in service:

(a) Tread worn hollow 3/8 in. in depth;

(b) Slid-flat or shelled out spots 3 in. long on driving tires.

4. Springs which will not carry the respective load when engine is standing, must be replaced.

5. Lateral motion at journal boxes shall be corrected when it becomes sufficient to cause serious interference between wheels and other parts of the locomotive.

6. Locomotives shall not be run with excessive lost motion between engine and tender.

7. Locomotives equipped with auxiliary couplings between engine and tender must have such couplings maintained in serviceable condition.

8. Locomotive tenders shall not be run with excessive clearances between rear side bearings.

9. In order that the engineman shall have sufficient illumination ahead of the engine to allow him to readily perform his duties while operating in and out of passenger terminals and industrial sidings, while switching in yard, and to readily locate whistle posts, yard limit and crossing signs and such other land marks en route, a headlight on a road locomotive shall not at any time during service have apparent beam candle-power less than the following; the readings to be made in a vertical plane 25 ft. ahead of the focal center and referred to points at various stations in the reference plane:

READINGS AT CENTER OF REFERENCE PLANE

| Reading point ahead of focal center | Apparent beam candle-power |
|---|---|
| 500 ft. | Not less than 450 cp. |
| 600 ft. | Not less than 490 cp. |
| 700 ft. | Not less than 500 cp. |
| 800 ft. | Not less than 500 cp. |
| 900 ft. | Not less than 500 cp. |
| 1,000 ft. | Not less than 500 cp. |

AVERAGE SIDE READINGS (AVERAGE OF READINGS TAKEN AT EACH STATION 20 FT. EACH SIDE OF THE CENTER)

| Reading points ahead of focal center | Apparent beam candle-power |
|---|---|
| 50 ft. | Not less than 30 cp. |
| 100 ft. | Not less than 110 cp. |
| 200 ft. | Not less than 225 cp. |
| 300 ft. | Not less than 315 cp. |
| 400 ft. | Not less than 350 cp. |

The above readings are to be considered independent of the location of the headlight, the source and intensity of light, the design of the reflector, etc.

In connection therewith, the Conference Committee of Mechanical Officers made the following statement:

"Our committee entrusted with the filing of rules is very much at a loss as to what the law really covers. On its face the law is to promote safety of employees and travelers on railroads by compelling common carriers, etc. The boilers which admittedly involve safety questions are already covered, and the same is true of ash pans and safety appliances. This leaves the machinery and tenders, which are inspected partly for safety and partly for economic reasons, not involving safety at all, and consequently not covered by this law.

"When all is said there are comparatively few defects which involve the question of safety, viz.: wheels, tires, springs, side bearings, and possibly one or two minor matters. Such matters as lateral play in boxes, condition of shoes and wedges, crossheads, and rod bushings, are not questions of safety, but purely economic ones in which the owner only is concerned."

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High-Velocity Steam Piping.—The advantages of small, high-velocity steam piping are lower first cost for pipe, valves and covering, etc., less erecting and maintenance cost; loss less weight; less radiation loss; less chance for water to accumulate and less difficulty with valves of smaller size.—*Power.*

# RAILWAY STOREKEEPERS' CONVENTION

## A Digest of the Reports and Papers Presented at the Twelfth Annual Meeting, Held in Chicago

The twelfth annual convention of the Railway Storekeepers' Association was held at the Hotel Sherman, Chicago, May 17-20. The association was welcomed to the city by Mayor Wm. H. Thompson. J. H. Waterman, superintendent of timber preservation, Chicago, Burlington & Quincy, replied to Mayor Thompson, and an address was made by E. D. Sewall, vice-president, Chicago, Milwaukee & St. Paul.

G. G. Allen, general storekeeper of the Chicago, Milwaukee & St. Paul and president of the association, said in his address that the association had prospered during the past year, 105 new members having been added, 20 of whom were from roads not previously represented. Referring to storekeeping practices, he emphasized the value of well-equipped storehouses in promoting economy, and advocated the employment of supply cars on roads whose location and physical condition lent themselves to such a practice.

The secretary-treasurer reported a total membership of 823, and $546 cash on hand.

### SCRAP AND SCRAP CLASSIFICATION

The real meaning of the word scrap is not fully understood by the average railroad employee. To most people scrap implies something useless, without value and to be disposed of only by being cast away. The fact that an article has been cast off does not imply in any way that it is without value for some other purpose. The economical handling of scrap in all of its phases is one of the most important items in railroad operation.

The cost of handling scrap should be considered carefully, as duplicate handling is very expensive. There are some kinds of scrap having such small market value that, if handled through one or two operations at scrap yards or on line of road, the actual cost of handling is greater than the amount realized from the sale of the scrap. On the other hand, with certain kinds of scrap one handling or operation, such as sorting out pieces of certain size or length, or cutting a few bolts and rivets, will result in a saving of several dollars per ton when the scrap is placed on the market.

Scrap should be picked up by section gangs daily and assembled at points designated, such as tool houses, etc. After it is assembled at these points it should be loaded at intervals suitable to conditions.

In loading scrap, rails and frogs should be loaded separately from track scrap, if possible. Mechanical scrap picked up off the right of way and in yards should be loaded separately; serviceable roadway material should be separated and transferred from time to time, instead of ordering new material.

Mechanical scrap should be forwarded to the nearest mechanical shops or supply yard for reclaiming. After reclaimed material has been removed, the car should be loaded to capacity with other scrap and forwarded to the place designated as a general scrap or supply yard, for making ready for the market.

In the handling of scrap, important features to consider are the equipment and back haul. The selection of equipment should be made from cars used for rough freight handling; consideration should also be given to the loading of scrap in open or closed cars to suit conditions at the general supply or scrap yard.

Another feature that should be followed up very closely is the loading of equipment to full tonnage. Oftentimes scrap is forwarded long distances with light load, whereas it could be started out with a light load and all scrap picked up until reaching general headquarters, by which time, if properly handled, the car would have its full tonnage.

Special care should be given to the switching of cars in and around scrap yards with a view of curtailing unnecessary switching. It is necessary that cars loaded ready for weighing be pulled out at certain intervals in order to save switching and as many cars as possible should be handled at this particular time, with the understanding, of course, that other cars will be set immediately for reloading. Scrap should not be loaded in foreign cars unless this is absolutely necessary, and in case it is loaded in foreign cars, the scrap yard foreman should give these preference in order to release the cars promptly.

[The committee suggested the special preparation of certain specified items of scrap not covered in the scrap specification, in order to obtain a better price, the understanding being that this will not change the present scrap classification.]

The report is signed by W. Davidson (chairman), Ill. Cent.; W. A. Linn, C. M. & St. P.; A. L. Tucker, C. & N. W.; H. E. Rouse, C. G. W.; J. F. Rothschild, C. B. & Q.; F. A. Bushnell, G. N., and H. Scatchard, N. & W.

*Discussion.*—Several members did not approve the addition of a classification for miscellaneous mixed scrap; others believed it necessary in order to provide for small roads without means of classifying and preparing scrap. Reference to the separation of high speed steel scrap brought out the fact that most roads do not have any to sell, a great many welding the small pieces on soft steel and thus using them up. Several members were of the opinion that scrap should be sold direct to the consumer and that the scrap dealer be eliminated. It was decided not to adopt the mixed and miscellaneous scrap classification.

### RECLAMATION OF MATERIAL

An abstract of the report of the Committee on Reclamation of Material, as well as a description of the Great Northern plant, will be found in the Shop Practice Section of this issue.

### ACCOUNTING FOR SECOND HAND SERVICEABLE MATERIAL

By C. H. SAMSON
Assistant Auditor, Chicago, Burlington & Quincy, Chicago, Ill.

With full appreciation of the highly important part it takes in the purchase of material, there is yet reason to believe that in nothing does a store department render greater service to the company it serves than in judicious and persistent efforts to avoid purchases.

Storekeeping is many-sided and only by developing all sides in their just relation and proportions to each other will the store department as a whole take and maintain its proper place in the railroad organization. Its primary object is to secure the most economical care and use of material and in that work, accounting, in its usual acceptation, though secondary and complementary, has an important part in that it puts the results of the care and use into record form, which is of value in proportion as it truly reflects the physical conditions and transactions.

Accounting for released material is somewhat different from other phases of material accounting in that it can be absolutely controlled in both the debit and credit, as the values are essentially arbitrary. The main consideration under such conditions is the use of values that will best harmonize with the values fixed by purchase and will be the most natural to apply. The commercial theory and practice in the handling of second hand material cannot be properly applied to railroad accounting as the railroad is its own best customer and there is neither profit nor sense in "robbing Peter to pay Paul," which is prac-

tically the case when one account or department is allowed to take advantage of another.

Material returned to store stock is naturally divisible into three classes for which fixed bases of value can be established:

1. Usable in its present form; value, same as corresponding new material.

2. Needing repairs to make it usable; value, a fixed percentage of corresponding new material when released and full value when repaired.

3. Scrap, not fit for use or repairable; value, fixed prices according to kind.

Considering these classes in the order named, as the physical condition of released material, whether salvage or unused, fixes the class to which it should belong, it is entirely practicable for store department men to determine when an article is usable and to account for it at its proper value, without any supplementary description of its condition, as the fact that it is issued for use is evidence enough. On the other hand, if usable second hand material is handled on a percentage basis, more or less distortion of the material account will surely follow. When received, any desired percentage can be readily applied, as there is no question then as to the fact that it is second hand, but in the issue the distinction must be made on the appearance of the article, and often by the average man under working conditions. However appealing the method may be in theory, and it looks good, in practice it is both unsafe and unnecessary.

As material in stock is issued at its stock value, regardless of the current market price, so should uniformity in value of second hand material be maintained, regardless of its particular use, with only such self-descriptive exceptions as are expedient on account of values and accounts involved, and they are surprisingly few.

As material needing repairs becomes usable when repaired, it naturally follows that its value, when released, should be the usable, or new value, less a percentage allowed for repairs. Before it is repaired, it is not available for issue and therefore cannot be charged to the material class from which the repaired article will be issued. The two conditions can be satisfactorily met by charging the released value and cost of repairs to a material class designated as scrap and crediting that class at usable value, as scrap can readily absorb, in its adjustment, all differences caused by the varying cost of repairs. The greater part of scrap ordinarily is sold, so that the actual value is determined by the market, but so far as the accounting is concerned the values can and should be fixed, subject to adjustment when the sales are made.

In the three sub-divisions, released material touches many phases of storekeeping and for its efficient handling and accounting demands the closest co-operation in the physical and accounting work. An effective working plan, therefore, must not only meet the various complications with definite rules, but must have rules that fit the working conditions at the physical end.

## RECOMMENDED PRACTICE

The committee, instead of presenting additional recommendations, feels that it is desirable at this time to call attention to the recommended practices already made by the association. Correspondence with about 50 railroads, reltive to the recommended practice, shows that on the whole great improvement in the economical handling of material could be made, provided many recommended practices as outlined by the association were actually put in use by the different roads.

Due to the different methods of handling and accounting, it is impossible at the present time to make a proper comparison of the efficiency of the stores department on the various roads. The greatest fault is with the storekeepers themselves, in not forcefully bringing these practices to the attention of their own roads, and calling attention to concealed expenses in handling material.

To properly compare the work of the stores department, we must have a common basis of arriving at the store expense, and a system of accounting which will not conceal or wrongly distribute the cost of handling material. It would appear that under the present rules of the Interstate Commerce Commission the cost of handling at least could be compared, but such is not the case. Store expense on many roads covers only the storekeepers' pay roll, practically all other expenses being charged to operating accounts. Many storekeepers do not do their own accounting. Storekeepers who actually do all the work that they should do and handle their organization properly are put in a false light by other storekeepers who only do part of the work and are only charged with a portion of the cost of handling and accounting for material.

It should be the duty of the auditing department to see that all the expenses of handling and accounting for material, no matter by what department performed, is charged to the proper account.

Attention was called to the report presented at the convention of 1914 by the accounting committee, and a paper in connection therewith; and the report of the committee on the book of rules, presented at the same convention. These two reports are so complete that the committee recommends that the association urge each member to submit them to their respective roads for adoption. The following in particular appears to be absolutely necessary to the efficient and economical handling of store department work:

The general storekeeper should have entire charge of all material belonging to the company, which is not actually in use, regardless of location. All unapplied material, new, second-hand or scrap, should be carried in his accounts and under his jurisdiction.

The accounting for all material in stock, necessary charges and distributions, including the making of vouchers, should be handled by the storekeeper and charged to store expense.

In order to arrive at honest comparisons, all labor expenses by other departments in handling material should be charged to the proper account—Material Store Expense. This will do more than anything else in placing the store department on a proper foundation.

The handling of scrap material and the sorting and reclamation of it is not properly a material store expense item and each department should stand the labor cost of the initial delivery to the store department. All labor expended by the store department in unloading, sorting, preparing for sale and loading should be charged to the value of the scrap as carried in the scrap class or account. The cost of reclamation should be charged to the article reclaimed as far as possible by the use of reclamation orders.

A classified statement of material received, issued and on hand should be made so that proper attention could be given to the different classes of material.

Disbursements should include only material actually used or disposed of; transfers between stores are not disbursements; labor in maintenance or construction of equipment should be excluded from material disbursements; material in course of manufacture, including labor expended, should be included as material stocks; temporary tracks and material suspense in connection with them should be excluded.

The importance of store delivery is not understood or appreciated on many of our railroads; consequently, it is not in general use.

While a majority of railroads operate supply cars, the greatest efficiency as regards their usefulness has not been reached. On many roads this car or cars simply distribute oil and a few light supplies. The supply car or train is the connecting link between the storehouse and the user of the material on the road, and should be the one great factor in properly handling and delivering on the ground all material, tools and stationery required for all departments and at the same time pick up all

scrap and surplus material and bring it to the storehouse.

The report is signed by D. D. Cain (chairman), S. A. L.; A. M. Gage, L. E. & W.; Clarence Foster, N. Y. C.; L. O. Genest, C. P.; J. J. Opheim, G. N.; W. A. Miller, Southern; H. C. Cook, S. P.; J. R. Mulroy, Pullman Company, and H. S. Burr, Erie.

## PIECE WORK

Previous papers and committee reports have fully outlined the advantages to be derived from the piece work system; have shown how to install and maintain the system; provided forms for records, and have also given a few concrete examples of economies which can be effected. There has seemed lacking, however, information as to the compilation and phraseology of the schedules, and this feature the committee has endeavored to cover in this report on a limited scale.

In making up a piece work schedule it should first be properly classified. The scrap dock employees would not be interested in schedules for handling lumber, nor does the ice house force care anything about schedules for handling rail and track material; hence it is recommended that the schedule be compiled in sections so that each shop or yard can be furnished that portion of the schedule which affects the work it has in hand.

It is not expected that the classification given will suit all cases, but should be modified to cover conditions as they exist in each individual case. The classification of the schedule is as follows:

Concrete products—manufacturing and handling; ice; lumber, switch ties, piling, poles and posts; miscellaneous storehouse material; rail and track material; scrap and reclamation material; signal material; tools and machinery; track ties and tie treating chemicals.

Schedules under the various classified headings should be arranged in numerical and alphabetical order. The heading "Miscellaneous Storehouse Material" may be sub-divided to suit conditions. One alphabetical index should cover the complete schedule.

[Examples were included in the report showing the method used in preparing the schedules.]

The following instructions should constitute a preface to each copy of the schedule.

All work unless otherwise specified is to be done by hand. Derrick prices and machine work includes all work, fixing tackle and machinery and doing the necessary switching, as well as transferring from previous jobs unless otherwise specified.

Loading includes getting material from the storage place, placing in the car, and properly blocking it for shipment unless otherwise specified.

Unloading includes taking from the car to the storage place, inspecting, taking out culls and properly piling or placing in racks or bins, unless otherwise specified.

Prices per "job" or per "trip" for derrick or hand work are to be paid only when it requires the extra switching or trips for the work. They are not to be paid when it does not require extra switching or trip and when the work can be done in connection with other work.

Rubble car prices include all handling of car to and from work, unless otherwise specified.

The report is signed by W. W. Eldridge (chairman), C. B. & Q.; B. W. Griffith, N. Y. C.; Geo. Holmes, M. C.; W. H. Thorn, C. St. P. M. & O.; F. J. McMahon, N. Y. C.; J. A. Stewart, N. Y. O. & W., and W. E. Brownell, Lack. Steel Company.

*Discussion.*—It developed that only a few roads were using piece work in the stores department, but that these few are well satisfied with the results which are being obtained. The Chicago & North Western finds a considerable increase in the work accomplished, and no neglect of inspection. More supervision is needed with piece work. Rates should not be cut when a man's earnings increase.

## ACCOUNTING—MATERIAL STORE EXPENSES

In recommending rules governing the accounting for material store expenses, the committee sets forth the principal and general expenses which are concerned and connected with store department operations. In the purchasing department, material store expenses are chargeable with the pay of general and local purchasing officers and their assistants and employees of the purchasing department; also, their traveling, office and other expenses incurred in purchasing material and supplies. The two exceptions are amounts expended for purchasing stationery, which are chargeable to stationery store expenses; and pay and expenses of officers and employees engaged in purchasing a single class of material or supplies, such as ties or fuel, which are chargeable directly to the cost of that particular class of material or supplies.

[Similar analyses of the charges against material store expenses are given for storekeeping, inspection, switching service, motive power and car departments, maintenance of way department, construction department, handling supplies for, and products from company industries, handling rail and ties, handling ice, handling bridge material, signal material, structural steel, etc., which is shipped direct to the jobs, handling scrap, and accounting.]

In the application and distribution of material store expenses, percentage rates, representing material store expenses, should be assessed according to the issues. The percentage should remain in effect until conditions may warrant a change, which may be made monthly or otherwise during the fiscal year.

Material store expenses are chargeable on the value of material issued for construction and additions and betterments, as well as for operating expenses; they are not chargeable in connection with transfers of material and supplies as between stores and stock accounts.

Material store expenses are chargeable on the value of the gross issues from stock, regardless of the value of scrap and second hand material released and received in exchange; they are chargeable on the value of the material issued to the shops for the manufacture of goods on store department orders and are also chargeable on the value of all shop manufactured goods issued from store stocks. Material store expenses should be assessed on the value of material and supplies sold from store department stocks.

A ledger account entitled Material Store Expenses should be established, for the specific and exclusive purpose of providing a suspense account through which to clear all debits and credits appertaining to the operation of the store department. This account should be credited with the amounts accruing from the application of the percentage for material store expenses to the value of goods issued. The balance in the account, if debit, would represent undistributed expenses due to the prescribed percentages being insufficient to clear the account; if credit, due to the prescribed percentage being greater than the percentages that would have cleared the account.

The account should be cleared in June account of each year by using for the prescribed percentages the rates of per cents that the actual expenses bear to the actual total material issues for the month.

Stationery store expenses should be handled separately from, but similarly to material store expenses.

The report is signed by P. J. Shaughnessy (chairman), Erie; E. L. Fries, U. P.; H. H. Laughton, Southern; E. E. McCracken, B. & L. E.; D. A. Williams, B. & O.; Chas. I. Davis, D. L. & W., and J. W. Camp, B. & M.

*Discussion.*—The discussion centered largely on the charging of expenses for the handling of scrap. In this respect the report

conflicted with the reports of the committees on Recommended Practices and Reclaiming Material, and was finally amended to agree with them.

## STATIONERY

The weak spot in the handling of the stationery supplies by the stores department is that the buying may then be done by a purchasing agent removed from the stores, and much unnecessary correspondence and referring of questions back and forth is entailed.

The strong points in favor of the handling of stationery by the stores department are: An organization for the handling of supplies and material, ordering, receiving, storing, distributing and accounting for. The receiving clerk or clerks of this organization can receive stationery at less additional cost than can a department created for that purpose alone; the porters who handle general supplies can handle stationery supplies at less additional cost than can porters who are maintained for that purpose alone; the distributing force which distributes general supplies can distribute stationery supplies in addition to general supplies at less cost than a force maintained for that purpose alone; the accountants who handle accounts for general supplies can handle the additional accounts for stationery at less cost than can accountants maintained for that purpose alone. All of these men having wider general training than would men handling stationery only, should do the work better.

The conclusions arrived at are:

1. That the handling of the stationery should be done in connection with the general stores.

2. That stationery should be charged out in detail, the same as other material and supplies.

3. That while the receiving, accounting and shipping facilities of the stores be made use of in the handling of stationery supplies, the stationery should be a department by itself within the stores, to the extent that the stationer devote his whole time to stationery matters, and that he be the stationery buyer. In no case should the general storekeeper be called on to do all the buying of stationery.

The stationery organization should be a part of the regular store organization under the general storekeeper, the staff to consist of the stationer, stenographer and stock room man, with the necessary help to handle the stock, according to the size of the road. Requisitions for purchase of stock supplies should be made up by the stock man. The requisitions should then be checked by the stationer and finally should be approved by the general storekeeper for purchase.

The stationery stock room should be of ample size and laid out in sections; a section to accommodate the forms belonging to each department, and a miscellaneous section to care for forms and supplies common to all departments. There should be a catalog of stationery made up in cheap form, so that it could be renewed at small expense, and a copy of this catalog placed in each office. The catalog should be made up to correspond to the stock room.

Each department should have its own series of numbers and symbols. Thus, the motive power department would be given 1 to 200, and its forms would bear its number and letter, thus—F. 160 M.P. Miscellaneous should have its own number and letter M. Each section should be marked with a small sign, as "Motive Power 1 to 200," and the pigeon holes, or shelves, numbered for the forms placed in them. In addition to the shelving for forms there should be, of course, a sufficient number of cupboards and drawers to hold the other material and supplies. The one thing absolutely necessary about a storeroom is that it be big enough.

The report is signed by E. J. McVeigh (chairman), G. T.; C. H. Rost, C. R. I. & P.; R. C. Crosby, Wabash; O. T. Burleigh, B. R. & P.; N. C. Foss, Ann Arbor, and R. A. Weston, N. Y., N. H. & H.

## SUBSTITUTES FOR EXPENSIVE LUMBER

BY W. H. CLIFTON
Lumber Agent, Baltimore & Ohio, Baltimore, Md.

As in other lines of industry, there are certain practices which are followed in the use of lumber in railroad shop and building work today, which have been unchanged for many years, regardless of the decrease in the supply and increase in the cost of the lumber used, or the fact that other kinds of lumber, equally well adapted to the purpose, are more easily and cheaply obtained. This condition seems to be due largely to a lack of knowledge of the characteristics of materials other than the ones which have always been used for certain purposes.

There are many occasions when 1 in. by 12 in. by 16 ft. white pine of good grade is ordered when 1 in. by 8 in. by 12 ft. to 16 ft. yellow pine cypress, spruce or even hemlock of a lower grade would answer equally well for the purpose, and would cost considerably less. White pine for pattern work is frequently ordered to be 12 in. and over in width, when, if ordered 8 in. and over with a limit on the percentage of widths under 12 in. acceptable, the lumber would cost less, and the widths under 12 in. will usually be found, piece for piece, to be of better quality than the wide stock.

Not very long ago, while passing through a cabinet shop in a railroad mill, I observed a large number of boxes or trays of a peculiar design in the course of manufacture. The boxes were being made from clear yellow poplar and were heavily ironed, and, I think, were mounted on small truck wheels. Upon inquiry, I was informed that they were to be used as tool boxes by machinists and car repair men for keeping together their wrenches and tools, and for moving them from one job to another. Now, when those trays were finished, they were beautiful to look upon, the bright yellow of the heart poplar standing out in contrast to the black iron branches, but the first time a car man threw his 18 in. wrench or his iron jack lever against the side or end of one of those boxes, an abrasion would appear in the soft surface of the wood in which one might lay a finger, and in a very short time the body and partitions of the box would be gone. Yellow pine or oak would have been a more durable material, and would have cost approximately 50 per cent less than the poplar, but the force in that shop knew little about yellow pine, except that it was more difficult to work, being harder in texture, and I believe, they considered oak too heavy; but they did know poplar and white pine and no doubt figured that, if it was good enough for cab panels and coach siding, it was good enough for the tool boxes.

The storekeeper did not use those tool boxes, but he supplied the stock to make them, and, perhaps, accepted the boxes in his stock and issued them. He is interested to the extent that, when the practice of using such expensive material for ordinary purposes is discontinued, he will have to carry less of it in stock and his stock balance will drop proportionately.

Noting, about a year ago, that a certain shop was ordering very frequently 1 in. by 16 ft. No. 2 white pine barn boards, inquiry was made as to the purpose for which they were used. Among other things, it was learned that quite a large quantity of the boards were being ripped to 2 in. and 3 in. strips and shipped out on the line for staying explosives in shipments and for stripping powder cars. Hemlock and chestnut cut to the desired size is now being purchased for this use at a cost of $18 to $20 per thousand feet. The white pine cost $27 to $32 per thousand feet. Old car siding and other waste material is also being used.

On two occasions, at different shops, it has been found that track shims were being made from new white oak purchased for gondola flooring, and, while it must be admitted that the shims were excellent and the size of the flooring was well adapted to the method of manufacture, little progress was being made toward economy, which would have been possible

by cutting up odds and ends and obsolete sizes of material, of which there was a considerable quantity available at both shops.

The cases mentioned are not exceptions, and are not peculiar to any one shop or railroad. Similar cases can, no doubt, be found to exist on many roads. The condition is the result of practices in effect when high grade lumber was cheap and plentiful.

A remedy is not hard to find or difficult to administer. Usually a little educating of the consuming forces in the possibilities of substituting, with a view of economy, brings the desired result, for the average mechanic on a railroad is not averse to saving money for the company if some one will show him how to do it and co-operate with him in accomplishing the desired result.

Some of the railroads have already gone quite extensively into the substitution of cheaper and more plentiful lumber. The Chicago, Milwaukee & St. Paul has found Douglas fir of suitable grades at a price ranging from $26 to $30 per thousand feet, and Washington cedar at $30 to $37 per thousand feet, to be excellent substitutes in many cases for soft yellow poplar at $65 to $90 per thousand feet. Both fir and cedar can be obtained in any width and thickness desired and can be satisfactorily kiln dried. While this company still uses yellow poplar for outside siding and interior finish on passenger cars, it has been able to cut the consumption of poplar to about 35 per cent of the quantity formerly used. It has also been found that clear red birch is an excellent substitute for mahogany for seat arms, etc., and at a considerable saving in cost.

The Baltimore & Ohio has very recently taken up the question of substituting red or gulf cypress for purposes for which soft yellow poplar has been used. For all purposes in which substitution has been made it answers equally as well as poplar, and, in some cases, it is superior to poplar for the purpose.

The following comparison of the approximate prices of first and second clear soft yellow poplar and the same grade of red or gulf cypress will give some idea of the saving which will be effected:

APPROXIMATE PRICES, F. O. B. CARS, CINCINNATI, OHIO

| First and Second Clear Soft Yellow Poplar | | First and Second Clear Red or Gulf Cypress | |
|---|---|---|---|
| Thickness | Price | Thickness | Price |
| 1 in. | $50.00 | 1 in. | $43.00 |
| 1¼ in. | 55.00 | 1¼ in. | 43.50 |
| 1½ in. | 52.50 | 1½ in. | 43.00 |
| 2 in. | 55.00 | 2 in. | 46.00 |
| 2½ in. | 60.00 | 2½ in. | 56.50 |
| 3 in. | 65.00 | 3 in. | 57.50 |
| 4 in. | 68.00 | 4 in. | 62.50 |

The specifications of the Baltimore & Ohio call for poplar 7 in. and over in width and 8 ft. to 16 ft. long; shipments must average 12 in. or over in width and 50 per cent of the boards must be 16 ft. long; only 10 per cent of 8 ft. and 10 ft. boards are admitted. The cypress can be purchased the same way.

It was formerly the practice on this road to use poplar for blocking in between the framing of baggage, mail and express cars to provide a soft absorbent surface to which glue is applied in putting on the outside sheathing. After a trial, it was found that a sound wormy grade of chestnut, kiln dried, could be used for this purpose with as good results as obtained from poplar. The chestnut cost approximately $20 per thousand feet; the poplar cost $55 per thousand feet.

Of course, steel is rapidly taking the place of lumber in car and locomotive work, and the possibilities of substitutions of cheaper woods in that class of work will grow constantly less, but there is on most railroads still a large amount of wooden equipment, which will be rebuilt and kept in service for years to come.

The committee on the Uniform Grading and Inspection of Lumber, of which J. H. Waterman, C. B. & Q., is chairman, presented a brief report outlining the action taken during the year. The chairman stated that very little could be reported owing to a series of disappointments. Various conferences with lumber manufacturers' associations which it was hoped would lead to a better understanding between the railroads and the manufacturers as to specifications, etc., did not take place. These conferences were cancelled or postponed through no fault of the committee.

In a brief address, in which he referred particularly to the paper by W. H. Clifton on Substitutes for Expensive Lumber, A. E. Manchester, superintendent of motive power of the Chicago, Milwaukee & St. Paul, told of cars in service for 35 years on his road equipped with siding and roofing of high grade white pine, the wood still being in perfect condition. He also mentioned a building which has recently been wrecked, the lumber costing at the time the building was erected, 50 years ago, nine dollars per thousand feet. After the building was wrecked this lumber was sold for $27 per thousand feet.

J. H. Waterman, superintendent of timber preservation, Chicago, Burlington & Quincy, condemned the practice of accepting rejected lumber for any use whatever.

G. G. Yeomans told of at one time accepting rejected lumber on the Burlington at lower prices until 50 per cent. of the contents of the yard was culls. Several purchasing agents stated that there was no trouble in getting good lumber if the poor quality lumber is refused and the shipper compelled to pay the freight both ways. About 15 of the railways represented at the convention refuse to accept rejected lumber at any price. A member told of receiving a number of draft timbers, some of which were 10 ft. 3 in. long and some 12 ft. long. The shorter timbers were all satisfactory while about 50 per cent. of the 12 ft. timbers were culls, the ends being in such a condition that the timbers had to be cut down to 10 ft. 3 in. The result of this practice was that the storekeeper was overstocked with 10 ft. 3 in. draft timbers, while there was a shortage in 12 ft. timbers.

## HANDLING SIGNAL MATERIAL

C. R. Ahrens, storekeeper, Delaware, Lackawanna & Western, Hoboken, N. J., presented a paper on the above subject, of which the following is an abstract:

All railroads do not handle signals and repair parts through their stores department. It happens to be the case on the Lackawanna and I believe the practice has been completely successful, both in keeping signal stock down to a minimum and in getting material to the place wanted at the right time, not only for repairs, but on new installations as well. This requires the greatest care and vigilance on the part of the storekeeper in charge of signal material; first, in order to meet the views of the management of the road; second, in regard to the needs of the signal department, in not delaying its work by failing to have material on the ground when wanted.

When a practical man cannot be secured for receiving clerk it will be found helpful on items of signal material, either for stock or direct shipment, to number each item ordered and request the signal companies furnishing them to show on their shipping notices the parts which apply on each item ordered; for instance, if a cylinder complete for a switch movement is shipped to us in three parts each part on the shipping notice is marked "Item 16" or whatever number the cylinder was numbered on our requisition.

We have a signal machine shop in the same building as our storehouse and all relays, mechanisms and such items returned to us for credit or repairs are turned over to this shop and, after they are looked over and repaired, we take them back and allow credit for the value, provided the signal department advises that the repaired material can be used in place of new. All classes of signal scrap are shipped to the division storehouse on each division, except worn out battery elements, for which we have a special place prepared.

R. D. Long, C. B. & Q., also presented a paper on this subject, in which he stated that the signal supply storekeeper should be

a practical signal man. An untrained man in this position can waste much material while a trained man can save much, particularly by reworking and using second hand material. A change in signals on this road made obsolete a considerable amount of material such as relays, etc. These were changed so that they could be made use of, and a considerable saving resulted. This could not have been accomplished without a signal man being in charge of the stores for this branch of the work.

### MARKING OF COUPLERS AND PARTS

The committee communicated with all the leading coupler manufacturers of the country and, while their suggestions were of some value, the members came to the conclusion, after tabulating various makes and styles of couplers and repair parts which are manufactured at the present time, that it would be better to number all parts, rather than to number a coupler and use a prefixed letter or letters to designate the parts. The committee therefore recommended the assigning of a series of numbers to each make of coupler and parts; the appointment of a standing committee to take care of assigning additional numbers as required; the publication of a booklet listing the various parts with the assigned numbers; and insistence, on the part of purchasing agents, on having manufacturers show, in raised figures whereever possible, the number applying to any particular part on the body of such part.

The committee submitted a list of such couplers and parts as it has been able to gather and has assigned numbers which it feels will give the desired results.

The report is signed by A. J. Kroha (chairman), C. M. & St. P., and L. H. Tutwiler, B. & O.

*Discussion:* The chairman of the committee stated that the manufacturers believe that all the information there is room for is now placed on couplers and parts, but he also stated his belief that if the association insists that the recommended numbers be placed on the couplers and parts, the manufacturers will agree to it. The report was adopted and referred to the American Railway Association for its action.

### STANDARDIZATION OF TINWARE

W. F. Jones, New York Central, the chairman of the committee on the Standardization of Tinware, stated that the committee had no printed reports but that the previous recommendations were still in the hands of a committee of the Master Mechanics' Association and the report was expected at the June convention in Atlantic City. The members of the association were referred to the issues of the *Daily Railway Age Gazette,* published at the Master Mechanics' and Master Car Builders' Association conventions at Atlantic City, for information as to the action of the Master Mechanics' Association.

### BOOK OF STANDARD RULES

The report of the committee on the book of standard rules consisted of an index for the book of rules which was adopted at the 1914 convention.

#### OTHER BUSINESS

J. H. Waterman, superintendent of timber preservation of the Chicago, Burlington & Quincy, presented a paper entitled "Butting In," in which he stated that the storekeeper had been made the "goat" for other departments long enough. Mr. Waterman considered that the storekeeper should "butt in" to the extent of examining critically all requisitions and substituting cheaper material if it was just as satisfactory.

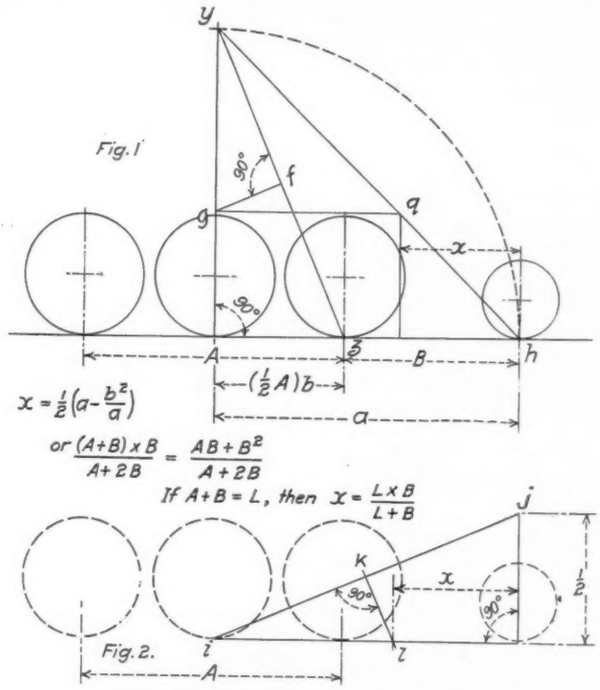
The following officers were elected for the ensuing year: J. G. Stuart, general storekeeper, Chicago, Burlington & Quincy, Chicago, president; W. A. Summerhays, general storekeeper, Illinois Central, Chicago, first vice-president; H. S. Burr, general storekeeper, Erie Railroad, New York, second vice-president, and J. P. Murphy, general storekeeper, New York Central, Collinwood, Ohio, secretary-treasurer.

## LENGTH OF RADIUS BAR FOR TWO-WHEEL TRUCKS

BY L. R. POMEROY

The function of leading or trailing trucks of locomotives should be to prevent the adjacent driving wheel flanges from grinding against the rail, and to compel the flange of the driving wheels to, in some measure, stand away from the outside rail in the case of leading drivers and the inside rail for rear drivers. The grinding action of the truck is proportional to the amount of such force that is exerted. This grinding action is practically nil if the radius bar pin is located at the geometrical or so-called "normal" point, as found by the graphic method or the usual formulas.

In order that the desired amount of guiding action may be effective, the "normal" length of the radius bar must be shortened sufficiently to exert enough stress to cause the truck to apparently enter the curve a certain per cent in advance of the position the truck would assume in relation to the curve, were the pin located at the "normal" point. The various percentages of the "normal" length, as shown by the tables presented, illustrates how design-




**Graphic Methods of Locating Radius Bar Pins**

ers differ as to the amount of reduction in length necessary. Out of 20 locomotives, taken at random, the length for trailer trucks averages 90 per cent, and for 14 locomotives with two wheel leading trucks the average is 95 per cent.

There is some particular location of the radius bar pin where the wear between the flanges of the adjacent driving wheels and the truck wheels is balanced or neutralized; this should be the ideal location. Tests made on the Delaware, Lackawanna & Western some years ago with a Mogul type locomotive furnished with an adjustable radius bar, illustrated the foregoing points very clearly. When the radius bar was too short the truck wheels showed excessive flange wear and the leading drivers comparatively slight wear. The reverse was clearly shown when the radius bar was too long or at the "normal" point. By this "cut-and-try" method it was found that if from 85 to 90 per cent of the "normal" length was chosen, very satisfactory results were obtained.

The writer has no record of similar tests with trailer trucks, but it would seem that such a test would be desirable, as the

trailer truck is "pulled" instead of "pushed" around the curve, and therefore the conditions are somewhat different.

Figs. 1 and 2 represent graphical solutions of the geometric location of the radius bar pin for two-wheel leading and trailing trucks. Fig. 1 represents the method used by the Grant Locomotive Works and furnished by the late Prof. J. G. A. Meyer, and is described as follows:

With a radius equal to one-half the driving wheel base, plus the distance from the center line of the forward driver to the center line of the truck wheel *h*, locate the point *y*, making the line *Ay* perpendicular to the base line; connect *yh*, and *yz*. Midway on the line *yz*, draw a line perpendicular to line *yz*, as at *f*; where the line *fg*, intersects the vertical line *Ay* draw a horizontal line to the right, meeting the line *yh*, at *q*; the horizontal distance from the vertical line at *q* and the center line through the center of the truck wheel equals, *X* the distance sought.

Fig. 2 is a graphic method used in England and was furnished the writer some years ago by the late William Ennis, when the latter was connected with the Rogers Locomotive Works. Draw a vertical line through the center of the engine truck axle and make this line equal in length to one-half the driving wheel base. From the center of the driving wheel base, *i*, draw a diagonal, meeting the vertical line through the center of the truck axle at *j*. Bisect this diagonal *ij* and draw the line *kl*, perpendicular to *ij*. Where the line *kl* meets the base line determines the length of the radius bar *X*, as in Fig. 1.

The following formulas will produce the same results as outlined in the description of the graphical methods of Figs. 1. and 2:

(a) $x = \frac{1}{2}\left(\frac{(a - \frac{b^2}{a})}{}\right)$ (b) $\frac{(A + B) \times B}{A + 2B} = \frac{AB + B^2}{A + 2B}$

By making $L = A + B$ the formula becomes easier to use, for then we have $x = \frac{L \times B}{L + B}$. The letters of the formulas refer to Fig. 1.

MACHINE TOOL EXPORTS.—The exports of metal-working machinery for January, 1915, reached a total of $2,903,740, nearly $500,000 in excess of those for December. Over January, 1914, the increase is approximately $2,000,000. In January, 1915, 935 commercial automobiles, valued at $2,545,527, were exported.—*American Machinist.*

COAL FOR COKE.—In the last five years the coal used in metallurgical coke manufacture has averaged around 65,577,000 tons, yielding 43,983,000 tons of coke valued at $111,736,000. Of this total, 14,767,000 tons were used in byproduct coke ovens, yielding, besides the coke 54,491,000 cubic feet of gas, 94,306,000 gallons of tar, and $9,190,000 worth of ammonia. When it is considered that every year approximately four times these enormous totals of byproducts are absolutely wasted through the use of non-byproduct ovens, the vital importance to the country of a general use of the modern, scientific byproduct ovens will be appreciated.—*Journal of the Franklin Institute.*

TWO-WHEEL TRUCKS

| | | Trailing | | | | Leading | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Builder | Locomotive, type | Radius bar or box | Per cent | Length by formula, inches | Length, actual, inches | Radius bar or box | Per cent | Length by formula, inches | Actual length, inches | Road |
| Baldwin | 2-10-2 | Bar | 95 | 87 | 83 | Bar | 83 | 88.4 | 73.5 | B. & O. |
| Baldwin | 2-10-2 | Bar | 97 | 84.5 | 81 | Bar | 96 | 86 | 82.5 | C. B. & Q. |
| Baldwin | 2-10-2 | Bar | 97 | 65.0 | 63 | Bar | 79 | 84 | 66.0 | A. T. & S. F. |
| Baldwin | 2-6-6-2 | Bar | 97 | 74.0 | 72 | Bar | 82.5 | 78 | 69.0 | C. B. & Q. |
| Am. Loc. Co. | 2-6-6-2 | Bar | 110 | 60 | 66 | Bar | 75.0 | 71 | 63.0 | B. & A. |
| Am. Loc. Co. | 4-8-2 | Bar | 92 | 88 | 81 | ... | .... | .... | .... | Mo. Pac. |
| Am. Loc. Co. | 4-8-2 | Bar | 86 | 84 | 72 | ... | .... | .... | .... | C. & O. |
| Baldwin | 4-8-2 | Bar | 86 | 83 | 71 | ... | .... | .... | .... | G. N. |
| Baldwin | 2-8-2 | Bar | 99 | 83 | 82.5 | Bar | 77 | 84 | 76.5 | B. & O. |
| Baldwin | 2-8-2 | Bar | 104 | 83 | 86 | Bar | 94 | 79.5 | 74.5 | G. N. |
| Baldwin | 2-8-2 | Bar | 97 | 87 | 84 | Bar | 95 | 77.5 | 73.5 | C. G. W. |
| Baldwin | 2-8-2 | Bar | 100 | 82.5 | 82.5 | Bar | 95 | 79.4 | 75.5 | B. & O. |
| Baldwin | 2-8-2 | Bar | 86.5 | 83.5 | 72 | Bar | 85 | 80 | 67.4 | Erie |
| Baldwin | 2-8-2 | Bar | 96.5 | 87 | 84 | Bar | 92.5 | 78 | 72 | I. C. |
| Baldwin | 2-8-2 | Bar | 95 | 82.5 | 78 | Bar | 94 | 85 | 79 | C. B. & Q. |
| Am. Loc. Co. | 2-8-2 | Rad. Box | 88 | 82 | 72 | Bar | 89 | 81 | 72 | C. & O. |
| Am. Loc. Co. | 2-8-2 | Rad. Box | 89 | 81 | 72 | Bar | 84 | 81 | 68 | D. L. & W. |
| Am. Loc. Co. | 2-8-2 | Rad. Bar | 85 | 81 | 69 | Bar | 80 | 85 | 67.5 | C. R. I. & P. |
| Am. Loc. Co. | 2-8-2 | Rad. Box | 85 | 81.2 | 69 | Bar | 87 | 80 | 69.5 | Mo. Pac. |
| Am. Loc. Co. | 2-8-2 | Rad. Bar | 97.2 | 71 | 69 | Bar | 100 | 69.5 | 70 | N. Y. C. |
| Am. Loc. Co. | 2-8-0 | Rad. Bar | .... | .... | .... | Bar | 98.5 | 71 | 70 | N. Y. C. |
| Am. Loc. Co. | 2-8-0 | Rad. Bar | .... | .... | .... | Bar | 71 | 79 | 66 | C. & N. W. |
| U. P. | 2-8-0 | Rad. Bar | .... | .... | .... | Bar | 93 | 67⅜ | 73 | U. P. |
| Baldwin | 2-8-0 | ..... | .... | .... | .... | Bar | 98 | 79½ | 78 | L. & N. E. |
| C. M. & St. P. | 2-8-2 | Box | .... | .... | .... | Bar | 84 | 80 | 67 | C. M. & St. P. |
| P. R. R. | 2-8-2 | Bar | .... | .... | .... | Bar | 86 | 78½ | 67¾ | Penn. |
| Am. Loc. Co. | 4-6-2 | Bar | 92 | 85 | 78 | ... | .... | .... | .... | No. 50,000 |
| Am. Loc. Co. | 4-6-2 | Bar | 86 | 80.5 | 69 | ... | .... | .... | .... | D. L. & W. |
| Am. Loc. Co. | 4-6-2 | Bar | 85 | 81 | 69 | ... | .... | .... | .... | C. & N. W. |
| Am. Loc. Co. | 4-6-2 | Bar | 89.5 | 87 | 78 | ... | .... | .... | .... | D. L. & W. |
| Am. Loc. Co. | 4-6-2 | Bar | 87.6 | 89 | 78 | ... | .... | .... | .... | Penn. |
| Am. Loc. Co. | 4-6-2 | Bar | 85 | 81 | 69 | ... | .... | .... | .... | Vandalia |
| Am. Loc. Co. | 4-6-2 | Bar | 86½ | 90 | 78 | ... | .... | .... | .... | N. Y. C. |
| Baldwin | 4-6-2 | Bar | 93 | 75 | 69¾ | ... | .... | .... | .... | G. N. |
| Baldwin | 4-6-2 | Bar | 94 | 75 | 71 | ... | .... | .... | .... | G. N. |
| Baldwin | 4-6-2 | Bar | 97 | 80 | 78 | ... | .... | .... | .... | D. & R. G. |
| Baldwin | 4-6-2 | Bar | 85 | 81 | 69 | ... | .... | .... | .... | N. Y. N. H. & H. |
| Baldwin | 4-6-2 | Bar | 86 | 80 | 69 | ... | .... | .... | .... | N. Y. N. H. & H. |
| Baldwin | 4-6-2 | Bar | 100 | 82.5 | 82.5 | ... | .... | .... | .... | B. & O. |
| Baldwin | 4-6-2 | Bar | 98 | 84 | 82.5 | ... | .... | .... | .... | A. T. & S. F. |
| Baldwin | 4-6-2 | Bar | 85 | 85 | 72 | ... | .... | .... | .... | C. & A. |
| **FOREIGN** | | | | | | | | | | |
| P. L. & M. | 2-8-2 | Rad. Box | 90 | 84 | 75 | Bar | 100 | 85 | 85 | ..... |
| P. L. & M. | 4-6-2 | Rad. Box | 89 | 85 | 75 | ... | .... | .... | .... | ..... |
| Bav. State | 4-6-2 | Rad. Box | .... | 94 | .... | ... | .... | .... | .... | ..... |
| Gt. W. (Eng.) | 4-6-2 | Rad. Box | 87 | 70.5 | 61⅛ | ... | .... | .... | .... | ..... |
| Gt. W. (Eng.) | 2-6-4 | ..... | .... | .... | .... | Box | 100 | 59 | 59 | ..... |
| L. T. & S. (Eng.) | 4-4-2 | Rad. Box | 104 | 60 | 63½ | ... | .... | .... | .... | ..... |
| Cent. Swiss | 2-6-0 | ..... | .... | .... | .... | Bar | 96 | 73.5 | 71 | ..... |
| Austrian State | 2-6-0 | ..... | .... | .... | .... | Box | 94 | 69½ | 65 | ..... |
| L. B. & S. C. | 2-6-0 | ..... | .... | .... | .... | Box | 98 | 73 | 72 | ..... |
| Italian State | 2-6-0 | ..... | .... | .... | .... | Box | 100 | 60 | 60 | ..... |
| Gt. W. (Eng.) | 2-6-0 | ..... | .... | .... | .... | Box | 87 | 70½ | 61⅛ | ..... |
| L. B. & S. C. | 4-4-2 | Box | 107 | 67½ | 72⅛ | ... | .... | .... | .... | ..... |
| L. & S. W. | 0-4-2 | Box | 100 | 61.2 | 61.2 | ... | .... | .... | .... | ..... |

# EXAMPLES OF RECENT LOCOMOTIVES OF THE MALLET, SANTA FE AND CONSOLIDATION TYPES

## ARRANGED IN ORDER OF TOTAL WEIGHT

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | 2-8-8-8-2 | 2-10-10-2 | 2-8-8-2 | 0-8-8-0 | 2-8-8-0 | 2-8-8-2 | 2-6-6-2 | 2-6-6-2 | 2-6-6-0 | 0-6-6-0 | 2-10-2 | 2-10-2 | 2-10-2 | 2-8-0 | 2-8-0 | 2-8-0 | 2-8-0 | 2-8-0 |
| Name of road | Erie | Santa Fe | Virginian | B. & O. | G. N. | Iron M. | B.R.&P. | N. & W. | D.&S.L. | N. Y. C. | Erie | B. & O. | C.B.&Q. | W.&L.E. | W. M. | K. & M. | M. & O. | B. & A. |
| Road number or class | 5014 | 3000 | 604 | 2401 | 2009 | 4000 | 701 | 1308 | 210 | 1300 | 4000 | 6000 | 6109 | 2401 | 781 | 552 | 547 | 176 |
| Builder | Baldwin | R. R. Co. | Amer. | Amer. | Baldwin | Baldwin | Amer. | Amer. | Amer. | Amer. | Baldwin | Baldwin | Baldwin | Amer. | Amer. | Amer. | Amer. | Amer. |
| When built | 1914 | 1911 | 1912 | 1911 | 1912 | 1912 | 1914 | 1912 | 1913 | .... | 1914 | 1914 | 1914 | 1913 | 1914 | 1914 | 1914 | 1914 |
| Tractive effort, lb. | 160,600 | 111,600 | 115,000 | 105,000 | 100,000 | 94,500 | 80,000 | 72,800 | 76,400 | 77,800 | 83,000 | 84,500 | 71,500 | 55,900 | 62,500 | 50,400 | 44,370 | 42,200 |
| Weight, total, lb. | 853,000 | 616,000 | 540,000 | 468,500 | 450,000 | 435,000 | 429,000 | 405,000 | 359,000 | 348,000 | 407,700 | 406,000 | 370,000 | 266,500 | 244,500 | 239,500 | 220,000 | 208,000 |
| Weight on drivers, lb. | 761,600 | 550,000 | 479,200 | 468,500 | 420,000 | 395,000 | 355,500 | 337,300 | 331,500 | 348,000 | 327,250 | 336,800 | 293,000 | 236,000 | 217,500 | 209,500 | 191,500 | 181,000 |
| Weight on leading truck, lb. | 32,000 | ..... | ..... | ..... | 30,000 | 20,000 | 24,500 | 22,700 | 27,500 | ..... | 24,350 | 22,700 | 27,900 | 30,500 | 27,000 | 30,000 | 28,500 | 27,000 |
| Weight on trailing truck, lb. | 59,400 | ..... | ..... | ..... | ..... | 20,000 | 49,000 | 45,000 | ..... | ..... | 56,000 | 46,500 | 49,100 | ..... | ..... | ..... | ..... | ..... |
| Weight of tender, loaded, lb. | ..... | 234,000 | 212,000 | 181,500 | 150,000 | 155,000 | 169,300 | 158,000 | 160,500 | 157,500 | 178,600 | 178,000 | 185,000 | 177,300 | 179,500 | 154,000 | 151,000 | 145,300 |
| Wheel base, driving, ft. & in. | 71—6 | 19—9 | 15—6 | 15—0 | 16—6 | 15—0 | 10—6 | 10—0 | 10—0 | 10—0 | 22—0 | 21—0 | 20—0 | 17—0 | 16—8 | 17—3 | 16—6 | 16—9 |
| Wheel base, total engine, ft. & in. | 90—0 | 66—5 | 57—4 | 40—8 | 52—6 | 56—7 | 49—10 | 48—10 | 39—1 | 30—8 | 41—3 | 40—3 | 40—1 | 27—0 | 26—2 | 26—5 | 25—1 | 25—3 |
| Wheel base, engine and tender, ft. & in. | 90—0 | 108—1⅝ | 91—5 3/16 | 77—2¾ | 83—1 | 85—2¼ | 81—5¾ | 79—3½ | 72—9 | 65—8 | 77—4½ | 76—6 | 74—9¼ | 62—3 | 68—0 | 58—2¾ | 61—6⅞ | 58—10½ |
| Diameter of drivers, in. | 63 | 57 | 56 | 56 | 63 | 55 | 57 | 56 | 55 | 51 | 63 | 58 | 60 | 57 | 51 | 57 | 63 | 56 |
| Cylinders, number | 6 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cylinders, diameter, in. | 36 | 28 & 38 | 22 & 44 | 26 & 41 | 28 & 42 | 26 & 40 | 23½ & 37 | 22 & 35 | 21 & 33½ | 21½ & 34 | 31 | 30 | 30 | 26 | 25 | 25 | 24 | 23 |
| Cylinders, stroke, in. | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 30 | 32 | 32 | 32 | 30 | 30 | 30 | 30 | 30 |
| Valve gear, type | Baker | Wals. | Wals. | Wals. | Wals. | Wals. | Wals. | Wals. | Wals. | Wals. | Baker | Wals. | Wals. | Wals | Baker | Wals. | Wals. | Baker |
| Steam pressure, lb. | 210 | 225 | 200 | 210 | 210 | 200 | 200 | 200 | 225 | 220 | 200 | 200 | 175 | 185 | 200 | 180 | 190 | 175 |
| Boiler, type | Conical | E. W. T. | E. W. T. | Conical | Belpaire | Straight | Straight | Straight | Conical | Straight | Conical | Straight | Straight | E. W. T. | Straight | E. W. T. | Straight | E. W. T. |
| Boiler, smallest outside diameter, in. | 94 | 79 | 101¼ | 89⅞ | 90 | 84 | 89¾ | 83⅞ | 84 | 83 13/16 | 90 | 90 | 88½ | 83 9/16 | 83¾ | 80 | 76 9/16 | 69 15/16 |
| Tubes, number and diameter in inches. | 326—2¼ | 377—2¼ | 334—2¼ | 277—2¼ | 332—2¼ | 260—2¼ | 235—2¼ | 243—2¼ | 235—2¼ | 272—2 | 262—2½ | 269—2¼ | 264—2¼ | 293—2 | 239—2¼ | 266—2 | 220—2 | 204—2 |
| Flues, number and diameter in inches. | 53—5½ | ..... | 48—5½ | 38—5½ | 42—5½ | 36—5½ | ..... | 36—5½ | 36—5½ | 40—5½ | 48—5½ | 48—5½ | 45—5½ | 43—5⅜ | 36—5½ | 36—5⅜ | 32—5⅜ | 30—5⅜ |
| Length of tubes and flues, ft. & in. | 24—0 | 16—5 | 24—0 | 24—0 | 24—0 | 21—0 | 24—0 | 24—0 | 20—6 | 20—0 | 24—0 | 23—0 | 22—7½ | 15—6 | 15—3 | 15—6 | 15—0½ | 14—9 |
| Heating surface, tubes and flues, sq. ft. | 6,418 | 3,625.0 | 6,350 | 5,205.5 | 6,120 | 4,381 | 4,547 | 4,659.9 | 3,882 | 3,980.7 | 5,443 | 5,215 | 4,966 | 3,293.4 | 2,919.3 | 2,926 | 2,395 | 2,185 |
| Heating surface, firebox, sq. ft. | 360† | 294.5 | 410 | 321.4 | 326 | 252 | 388 | 343.2 | 229 | 265† | 295† | 293† | 383† | 223.7 | 228.5† | 227† | 173 | 298† |
| Heating surface, total, sq. ft. | 6,994§ | 6,579‖ | 6,760 | 5,526.9 | 6,446 | 5,763‖ | 4,935 | 5,029.3 | 4,111 | 4,245.7 | 5,801 | 5,638a | 5,349 | 3,517.1 | 3,147.8 | 3,153 | 2,568 | 2,383 |
| Heating surface, superheater, sq. ft. | 1,584 | 2,328¶ | 1,310 | 1,002.0 | 1,368 | 890 | 1,025.5 | 984.8 | 879 | 948 | 1,377 | 1,329 | 1,332 | 774 | 594.4 | 633 | 545.8 | 496 |
| Heating surface, equivalent,* sq. ft. | 9,262 | 8,907 | 8,070 | 6,528.9 | 7,814 | 6,653 | 5,960.5 | 6,014.1 | 4,990 | 5,193.7 | 7,866.5 | 6,901 | 7,197 | 4,291.1 | 4,039.4 | 3,786 | 3,113.8 | 2,879 |
| Grate area, sq. ft. | 90 | 81.9 | 99.2 | 99.9 | 78.4 | 84 | 72.2 | 72.2 | 72.2 | 53.6 | 88.1 | 88 | 88 | 66.75 | 61.3 | 55 | 53.1 | 46.8 |
| Firebox, length, in. | 162 | 149⅝ | 174 | 126 3/16 | 117¼ | 126 | 108⅛ | 109 | 108 1/16 | 127⅛ | 132¼ | 132 | 132 | 114 | 111 | 108⅛ | 106 9/16 | 108⅛ |
| Firebox, width, in. | 108 | 78¾ | 109 | 114 | 96¼ | 96 | 96¼ | 97 | 96¼ | 75¼ | 96 | 96 | 96 | 84¼ | 80¼ | 73¼ | 71¾ | 62¼ |
| Kind of fuel | Bit. coal | Oil | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal | Bit. coal |
| Tender, fuel capacity, tons or gallons | 16 | 4,000 | 15 | 16 | 13 | 14 | 14 | 14 | 12 | 12 | 16 | 16 | 15 | 15 | 14 | 16 | 12 | 12 |
| Tender, water capacity, gal. | 10,000 | 12,000 | 12,000 | 9,500 | 8,000 | 8,000 | 9,000 | 9,000 | 9,000 | 8,000 | 10,000 | 10,000 | 10,000 | 9,000 | 9,500 | 7,500 | 7,500 | 7,500 |
| Weight on drivers ÷ tractive effort | 4.76 | 4.95 | 4.16 | 4.46 | 4.20 | 4.17 | 4.44 | 4.62 | 4.34 | 4.47 | 3.94 | 3.99 | 4.1 | 4.23 | 3.52 | 4.16 | 4.32 | 4.29 |
| Total weight ÷ tractive effort | 5.33 | 5.52 | 4.70 | 4.46 | 4.50 | 4.60 | 5.36 | 5.56 | 4.70 | 4.47 | 6.18 | 4.81 | 5.2 | 4.77 | 3.91 | 4.75 | 4.96 | 4.93 |
| Tractive effort × diam. drivers ÷ equivalent heating surface* | 1,088.3 | 714.2 | 798.2 | 900.6 | 806.3 | 781.2 | 765 | 677.9 | 842.1 | 764.0 | 664.72 | 710.2 | 596.1 | 742.5 | 789.1 | 757.1 | 897.7 | 820.8 |
| Equivalent heating surface* ÷ grate area. | 102.9 | 108.8 | 81.4 | 65.4 | 99.7 | 79.2 | 82.6 | 83.3 | 69.1 | 96.9 | 89.29 | 78.4 | 81.8 | 64.3 | 66.0 | 68.9 | 58.6 | 61.5 |
| Firebox heating surface ÷ equivalent heating surface*, per cent | 3.89 | 3.31 | 5.08 | 4.92 | 4.17 | 3.79 | 6.51 | 5.71 | 4.58 | 5.11 | 3.75 | 4.25 | 5.33 | 5.20 | 5.65 | 6.00 | 5.56 | 10.35 |
| Weight on drivers ÷ equiv. heat. surface*. | 82.2 | 61.7 | 59.4 | 71.8 | 53.7 | 59.4 | 59.6 | 56.1 | 66.4 | 67 | 41.6 | 48.8 | 40.7 | 55.0 | 53.9 | 55.4 | 61.5 | 62.9 |
| Total weight ÷ equiv. heating surface* | 92.1 | 69.2 | 67 | 71.8 | 57.6 | 65.3 | 72 | 67.5 | 72 | 67 | 51.8 | 58.9 | 51.4 | 62.1 | 60.5 | 63.2 | 70.6 | 72.3 |
| Volume both cylinders | 51.3 | 30.1 | 34.4 | 30.0 | 32.2 | 29.3 | 24.5 | 21.8 | 20.0 | 19.1 | 27.9 | 26.2 | 26.2 | 18.50 | 17.0 | 17.0 | 15.7 | 14.4 |
| Equiv. heating surface* ÷ vol. cylinders. | 180.5 | 296 | 235 | 217 | 243 | 228 | 244 | 276 | 249 | 272 | 281 | 264 | 274 | 232 | 238 | 223 | 198 | 200 |
| Grate area ÷ vol. cylinders | 1.75 | 2.72 | 2.88 | 3.33 | 2.44 | 2.87 | 2.95 | 3.32 | 3.62 | 2.81 | 3.15 | 3.36 | 6.7 | 3.60 | 3.61 | 3.24 | 3.38 | 3.25 |
| Reference to photographs, drawings or description | R.A.G.M.E.‡ 1914-p227 | Am.Engr. 1911-p171 | Am. Engr. 1912-p287 | Am.Engr. 1911-p182 | Am.Engr. 1912-p587 | Am.Engr. 1912-p420 | ..... | ..... | ..... | ..... | .....R.A.G.M.E.‡ 1915-p160 | ..... | ..... | R.A.G.M.E.‡ 1913-p641 | R.A.G. July 1914-p101 | ..... | ..... | ..... |

* Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface. § Includes 108 sq. ft. combustion chamber heating surface. ‖ Includes feed water heating surface. ¶ Buck-Jacobs low degree superheater. a Includes 65 sq. ft. combustion chamber heating surface. † Includes arch tube heating surface. ‡ *Railway Age Gazette, Mechanical Edition.*

# CAR DEPARTMENT

## THE SHIPPER, THE RAILWAY AND THE CAR MAN*

BY F. C. MAEGLY
Assistant General Freight Agent, Atchison, Topeka & Santa Fe, Chicago, Ill.

The shipper wants the railway to make it easier, cheaper and safer for him to load, ship and unload his freight. Any condition inherent in car equipment which makes it more expensive and inconvenient for him is prejudicial. On the other hand, anything that the car man can do to make it easier, cheaper and safer to load, ship and unload freight will improve the relation between shipper, railway and car man. Posing as the shipper's advocate, I feel free to offer criticisms and suggestions regarding the car man's performance.

Car men tell me that the draft rigging of railway equipment is the vital part. Many recommend that the draft rigging of all cars be sufficiently strong to withstand the shocks and strains incident to train and yard service. Any car, whether weak or strong, is likely to be placed in any position in long freight trains. The parting of trains, the break-in-twos, cause wrecks and damage my freight. I am anxious to have your co-operation in avoiding such damage. Your answer is that the cars are handled too roughly in many of the large terminal freight yards, and in many of the long freight trains; but has the car man done his part? Was the inspection of the cars adequate in the first place? Were the repairs sufficient? Where cars bear evidence of rough handling, was an effort made to locate the yards, and the trains, and the employees responsible? And were the proper representations made to the proper officers?

I recently inquired of a yardmaster, "Why so many break-in-twos, and so much car damage?" He took me to a freight car and pointed to features of the draft rigging which he said were "rotten"; he took me to another car with different style of draft rigging and stated that it gave far less trouble than the one first inspected; he took me to still another, and said that it was practically free from the faults mentioned in the other two.

The superintendent of motive power of a large railroad recently explained to me how very important it is to see that the air brake appliances are in good condition when locomotives and cars leave shops and repair yards or points of inspection. The general superintendent of a large railway system told me that if given 100 per cent air brake efficiency he would be able to solve the problem of trains parting on his district. A car man of much experience told me that too often cars are allowed to run with defective air brake hose and connections; that a campaign of closer and more effective supervision would help greatly to eliminate air brake failures.

Doubtless every member of the Car Foremen's Association is aware that the railroads of the United States have been expending annually about $30,000,000 in the payment of loss and damage claims; therefore it will not be amiss for me to deal briefly with the several types of freight cars, and the features which tend to disturb pleasant relations between the shipper, the railroad and the car man.

### BOX CARS

Why is it necessary to provide two men and a crowbar to open and close the side doors of a large percentage of the available box car equipment? If anyone disputes this, I invite him to visit a railroad yard at a market center where grain is inspected and sampled. The damage frequently done to car sheathing in the mere process of opening and closing side doors of box cars with crowbars is appalling. If the car man is not primarily responsible, he is to blame in a secondary way for not formulating a definite protest against many of the present-day side door installations. A car man recently told me that fully 20 per cent of the delays to box cars for repairs is incidental to the side doors.

During the five crop years ending June 30, 1914, the Chicago Board of Trade weighing department registered grain leakage defects against the following number of individual cars:

| | |
|---|---|
| During 1909-10 | 20,123 cars |
| During 1910-11 | 25,010 cars |
| During 1911-12 | 22,909 cars |
| During 1912-13 | 32,760 cars |
| During 1913-14 | 23,127 cars |
| Total | 123,929 cars |

Here the car man is presented with evidence of an average of 24,786 cars per year, or 69 cars daily that have grain leakage defects. Would it not be a good idea to take these cars at a time when the exact location of the defect is known, and when the minimum of attention by an effective car repairer would effectively prevent grain leakage by the same defect for a long time to come? The Chicago Board of Trade weighing department has offered to co-operate with the railroads in any systematic effort to eliminate these grain leakage defects; they have even agreed to furnish the interested carrier with a diagram showing the precise location and character of each defect as found by their deputies.

The front, top and rear creases of car doors should be rain tight, and I am happy to say that car builders are gradually approaching this much desired end.

All car door fasteners should be simple and effective, and when sealed, it should require the breaking of the seal to make it possible either to enter the car or remove freight through the doorway. The top and rear of the door should be so encased as to make it impossible to pry the door sufficiently to pilfer freight, and it should not be practicable with tools to remove the guides or lugs from the outside of the car while the car door is properly latched and sealed. Many box cars are now free of the last mentioned defects; some, however, are not.

The door posts of box cars should be about 100 per cent stronger. Car builders evidently have failed to reckon with the immense strains to which car door posts are subjected by the loading of bulk freight shipments, and particularly when releasing such commodities as bulk grain at the points of unloading. The structure over which the car door travels should be of such strength and rigidity as not to bulge or swell under heavy lading, or during abnormally wet seasons, so as to cause a bind between the door and the siding of the car when opening or closing the doors.

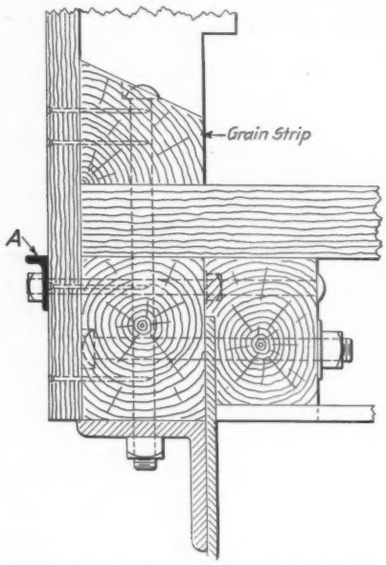
The car man who will provide effective and economical means of protecting car sheathing against shrinkage and warping should be amply rewarded. One car man has suggested that all sheathing boards be dipped in suitable paint before being applied; another is applying an angle iron all around the car body, as shown at *A* in the accompanying sketch. This angle iron is bolted through the car sill, and there have been marked benefits from it as regards grain leakage.

Try to prevent car builders from using hard wood for grain strips. Persuade them to use soft lumber and see that the grain strips are made considerably larger, and then even though it does take two men to apply them, have the sheathing

*From a paper read before the Car Foremen's Association of Chicago, May 10.

boards nailed to the grain strips, so that if a sheathing board should give way at the car sill, it will still be attached to the grain strip. There are some who advocate that the grain strip be not nailed to the car floor, but preferably to the sheathing boards. The sketch shows an extra heavy grain strip of soft wood, which, it will be noted, is bolted through the car floor and sill. The sheathing is nailed to the grain strip as well as to the car sill.

Some car men advocate the elimination of end doors, particularly in cars 40 ft. long or longer. It is questionable whether the end doors even in 36 ft. cars are worth the trouble they make. The repairs to the end doors of box cars are a considerable item. If they must be tolerated, let them be very small and at one end only, and let the joints be of such a character as to avoid the leakage of rain into, or of




**Methods of Preventing Grain Leakage**

commodities out of the car. Every end door should be provided with an effective latch, which may be fastened from the inside of the car, thus rendering the sealing of the end door necessary only when the car is loaded with long material which cannot be handled through the side doors.

Car builders do not pretend that box car linings are grain tight at the belt rails. If linings could be made grain tight from the floor to carlines, the leakage of bulk grain during transit could be entirely eliminated. During the six months from January 1 to June 30, 1914, carriers reporting their loss and damage to the American Railway Association showed nearly $600,000 paid out for loss of grain on account of defective equipment; $854.000 was paid out during the same six months' period on grain and grain products. Estimating twice these amounts for the 12 months, we have from $1,200,000 to $1,600,000 annual loss of grain chargeable to box car defects. This is five per cent every year on from $24,000,000 to $32,000,000. A great many improvements could be introduced in the structure of the box car to prevent this drain upon the carriers' revenues. Speaking for the shipper of bulk grain, I would unhesitatingly advocate a galvanized liner back of the car lining, and in matching the car lining I would seek to taper one edge so as to insure against grain lodging on the longitudinal edges. Shippers of flour and other like package freight, particularly the shipper of fragile packages, would greatly appreciate a smooth surface instead of the sharp edges at the belt rail and the bottom. The car man will object to this on the ground that the lack of ventilation between lining and sheathing would lead to premature decay. Some car men, however, take issue with this view and say that they have proof of its fallacy by a study of the decay in like parts, and in the sills of refrigerator cars. One of the grain carrying road's expenditures for burlap and paper to patch minor defects during one shipping season amounted to between $50,000 and $60,000. It is questionable whether a carrier ought to supply shippers with free burlap to properly secure their grain in cars, the burlap pertaining to private packing rather than public equipment, and all cars from the newest to the oldest require adequate coopering for bulk shipments to insure against leakage; nevertheless, competition and the disparity between individual freight cars available for bulk grain loading has been such as to cause carriers to supply these accessories in addition to grain doors. The same road's annual expense for grain door renewals has averaged about $105,000 a year, on an annual movement approximating 75,000 cars. However, many of the grain doors are lost by reason of shipments discharging at destinations beyond the originating carrier's rails.

If you car men desire to establish permanently happy relations between shipper, railroad and car man, please provide a box car that is free of the several defects just mentioned.

### COAL CARS

Hopper bottom, drop bottom and drop side cars should be so constructed and so maintained that the drops and hoppers when closed will be secure against leakage of the commodity from the car during transit. Chains and other fastenings, and the gears used to operate them should have an immense factor of safety over and above the anticipated strains, and every necessary preventive should be provided against the warping of material and consequent leakage defects. The apparatus used to hold hoppers and drops should be simple and easy to operate, and the many shelves and dirt collecting pockets now existing in various types of hopper and drop bottom cars, which collect and conceal refuse, also the false decks of projecting ends of hopper bottom cars, should be eliminated for the reason that refuse will gather thereon, often to the detriment of the railroad, the shipper and the consignee.

### STOCK CARS

The stock shipper desires a smooth interior with spaces between slats only wide enough to admit of sufficient ventilation of the stock while in the cars. Many of these spaces are now too large. It is to be hoped that a convertible stock car will some day be devised so that this type of car may be used more extensively for the transportation of other commodities. Several of the roads have lined stock cars with heavy fibre or felt paper at an average expense of about $17 a car. These cars did well during the temporary period of such special service, and provided just that much relief against box car shortage during the rush of grain.

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Saving Waste Grain.—The Rock Island agent at the Silvis (Ill.) transfer, constructed a rat-proof grain bin last Fall, holding 25 to 30 bushels of grain, and began systematically to save the grain recovered in the sweeping of empty cars placed at the platform for loading. This was done at practically no expense, as it was necessary to clean the cars before loading and regular employees were utilized in the work. As opportunity offered he also collected any grain spilled from bad order cars in the Silvis yards. This grain was sold from time to time and the receipts turned into the company treasury through the local agent. While this grain was damp and more or less dirty, it made good chicken feed and no difficulty has been found in selling it at $0.80 per hundred pounds. The amount recovered in four months was as follows:

| | |
|---|---|
| November, 1914 | $15.05 |
| December, 1914 | 71.80 |
| January, 1915 | 64.10 |
| February, 1915 | 116.60 |
| Total | $267.55 |

# AIR BRAKE ASSOCIATION CONVENTION

## Moisture in Compressed Air Apparatus, Pneumatic Signal Operation, and 100 Per Cent Operative Brakes

The twenty-second annual convention of the Air Brake Association was held in Chicago, May 4 to 7, L. H. Albers, New York Central Lines, presiding. The meeting was opened with prayer by Rev. Martin J. Magor, and the address of welcome was made by Robert Quayle, general superintendent of motive power and car department, Chicago and North Western. Mr. Quayle complimented the association on the work of the past and pointed out its possibilities in the future. He spoke of the importance the air brake engineer bore to the railroads and the public, stating that such was their work that men of good character, patience and thoroughness were required. The air brake men are responsible to a large extent for the safe and careful operation of trains and their work and instructions should be of the first quality. The problems presented by the air brakes are many and only by persistently keeping after them may they be conquered.

### PRESIDENT'S ADDRESS

President Albers called attention to the lack of standardization of brake equipment for passenger cars, and was of the opinion that a committee from both the Air Brake Association and the Master Car Builders' Association could by careful study decide on some standard valve of simple construction that would do much to relieve the situation. He spoke of the difficulties experienced, principally "stuck-brakes," with the various types of passenger air brake equipment now in use. While the new P. C. equipment provided temporary relief from the troubles experienced with the P. M. and L. N. type of equipment, its complexity renders it difficult to locate immediately and definitely defects which arise in train service.

Mr. Albers also called attention to the necessity of economy in the maintenance of air brake equipment with full consideration for safety. On the New York Central Railroad, East of Buffalo, tests have been in progress for a period of 18 months, on 18 dining cars, and to this date 16 cars are still in actual service with an aggregate mileage of 2,321,136 miles without once having received any attention or lubrication except when they were applied. None of these cars have given any detention on account of the air brake equipment, nor has any valve been removed except for examination after 12 months had passed. He stated that if the cleaning period, instead of being three months as at present, were extended to four months the annual saving to a road having 1,000 P. C. equipment cars would amount to approximately $1,640, and if extended to six months the saving would be approximately $3,280. With the P. N. or L. M. type of equipment this saving would be $420 and $840, respectively. He believed that if these particular features of air brake maintenance were given proper attention at the time of cleaning the time between cleanings could be lengthened with a consequent saving.

### MOISTURE IN YARD TESTING PLANTS

The benefit derived by having compressed air available in railroad storage yards, so that the air brake apparatus can be properly inspected, has long been recognized by air brake men. However, the importance of providing what is generally termed "dry air" has not been given the consideration it should have in some of the installations.

The importance of preventing water entering the air brake system when passenger trains are charged in the Mott Haven yard of the New York Central, which is the passenger car storage yard for the Grand Central Terminal at New York City, was recognized by the management, and in the fall of 1913, an air cooling plant was erected and has been in successful operation since. No trouble from freezing of the radiating pipes has occurred and the plant has absolutely prevented any precipitation taking place in the yard pipe.

The two compressors at the Mott Haven yard have a total capacity of 2,500 cu. ft. of free air per minute. There was provided in this plan 3.2 running feet of ¾ in. pipe for each cubic foot of free air that the compressor was capable of producing, or, in other words, 8,018 ft. This is made up into 48 sections, each of which is composed of two headers and 18 pieces of ¾-in. extra heavy galvanized pipe about 111⅜ in. long spaced on 2½-in. centers. The upper header is 6 in. in diameter and the lower one 8 in. in diameter. Both are of extra heavy wrought iron. Cast iron caps, tapped for 1 in. pipe at the center, are used to close the ends of the headers.

The lower header is tapped for 1 in. pipe at the center lengthwise and 180 deg. from the ¾-in. holes, this connection being used for a drain. Each of the 18 pieces of ¾-in. pipe are made up of two sections of different lengths.

The long and short pieces were alternated in the headers, so that the joining of two sections in any one of the 18 pieces does not interfere with any of the others. The two outside pieces, that is, the first and eighteenth pieces of ¾-in. pipe are joined together by the use of ⅜-in. brass ground joint unions. The other 16 pieces of ¾-in. pipe are jointed by the use of slip joints, known as grip couplings, which are manufactured by the Ware Coupling & Nipple Company, Ware, Mass. The 48 sections are arranged in two groups of 24 each, designed so that all the piping is accessible, there being ample clear space to work in. Sufficient space is provided for the circulation of the atmosphere around the cooling pipes, a very important factor.

There are two storage reservoirs, 4½ ft. in diameter, by 11 ft. high, and the air first passes through both of these reservoirs. From the storage reservoir air is delivered to the yard through a 6-in. main and can be directed through the manifold condenser, or by-passed around it. A 6-in. pipe between the two groups, extends from one end to the other near the top. This is the admission pipe. It has 24 pipe connections, 2 in. in diameter, from each of which two 1-in. pipes branch. Each 1-in. pipe is connected to the end of the upper header of a section, directly opposite the 2-in. risers, one in each group. The outlet is a 6-in. pipe, on the outside of either group, running the entire length and across one end. The connection to the main pipe is made by a 6-in. riser. Connections are made to the outlet pipe from the lower header of each section with 1-in. pipe.

These connections to the section are diagonally opposite to the inlet connections, it having been found that with the inlet and outlet on the same side of a section the flow of air was greater through the cooling pipe nearest that side. There are cut-out cocks provided so that any one of the 48 sections can be cut out without interfering with any of the others. Each lower header is provided with a drain cock which is in communication with the sewer pipe. Also, there is a drain provided for the inlet and outlet pipes.

The report is signed by Mark Purcell (Nor. Pac.), and M. F. Gannon (N. Y. C.).

#### DISCUSSION

Some roads have found that very good results can be obtained by placing reservoirs in the yard piping to catch the moisture as it becomes condensed in the pipes, these reservoirs to be drained twice a day. It was also pointed out that the compressor should have its intake located outside the building where it could obtain air as cold as possible. Trouble has also been

experienced with the yard pipes becoming full of water when the hydrostatic tests were made on the air system reservoir, the water leaking by the valves that were not in good condition. When such tests are made it was recommended that the pipe connections to the yard piping be disconnected.

The discussion also developed into the consideration of the accumulation of moisture in the train line. Sufficient radiating surface should be provided between the compressor and the main reservoir, this amount varying from 18 ft. to 40 ft. of 1¼-in. pipe. It should be located so that it will drain into the main reservoir. It was also recommended that two main reservoirs be used, one of which would serve as a drain for the air system. On large Mallet locomotives it has been found necessary to provide three such main reservoirs. It was also stated that where the air capacity was not sufficient and the pumps were called upon to pump the brakes off the train, trouble would be found with the accumulation of moisture in the train line.

Excellent results have been obtained by having the roundhouse hostlers open all the drain cocks on the locomotive and tender as soon as the engine was housed. Care should be taken in the locating of the various air brake equipment. The distributing valve should be located so that it will be drained, and the main reservoir should not be located too near the firebox, as in such cases it has been found that the air would not cool sufficiently to precipitate the moisture. Where the power reverse gear is operated by both steam and air, the air line should be provided with a check valve so that the moisture from the steam could not work back into the air system. Centrifugal dirt collectors have been found to serve admirably as drains for the train line, and in some cases two are installed on the cars for that purpose.

## OPERATION OF THE PNEUMATIC TRAIN SIGNAL

Possibly the largest factor in the correct operation of the signal device is maintenance. This is particularly true of the amount of leakage allowed in the signal line. With the long cars which are in service today, the most frequent place for leakage to develop is at the hose connections, due to the improper location of the pipes at the end of the car, which results in false signals being transmitted. This destroys the confidence of the crew in the signal system. In order to get the best results, the location of pipe and hose should be as recommended by the M. C. B. association.

Where the reducing valve of the slide valve feed valve type is used, the opening through the choke of the combined strainer and check valve has been increased on some roads from 3/32 in. to ⅛ in. A test of a twelve-car rack shows very little difference between the two; in fact, the condition of the feed valve will affect the recharging of the line as much as the difference in the size of the choke. Where this type of reducing valve is used they should be cleaned once a month, and subjected to the same rack test as the feed valves used to control the brake-pipe pressure.

In endeavoring to improve the operation it is necessary to first ascertain the conditions under which the signal is operating. Recording gage charts attached to the signal line on the rear car will indicate the average operating conditions as follows: the pressure carried in signal line; all reductions in this pressure, whether made by pulling cord or by hose couplings leaking when passing over crossovers, switches, etc.; and the time required to recharge the line after reductions have been made. It has been found necessary for the trainmen to make a reduction at the car discharge valve of not less than one second duration, and pause between the reductions two to three seconds, or approximately three times as long as the time of the reductions.

While there is a limit to the length of signal line which can be operated successfully with the present pneumatic signal, it is believed that the electro-pneumatic signal which does not have the same limitation, will eventually be adopted. During the past year a steam train equipped with the electro-pneumatic system has been in regular service, covering 180 miles a day, with good results.

The construction of the signal valve is such that very careful workmanship is required in order to have the correct clearance between the valve stem and its bushing. If this clearance is insufficient, the valve will be too sensitive and give false blows of the whistle for very slight signal pipe reductions. If the clearance is excessive, heavier reductions are required than when the fit is tight. The average signal valve has about .0005 in. difference between the diameter of the stem and the bushing. The manufacturers have found that where this difference is less than .0002 in., or more than .0015 in., the valve will not meet the requirements.

The small projection at the bottom of the valve stem is 1/32 in. long, and with a proper fit in its bushing, requires that the diaphragm must raise more than 1/32 in. before enough air can flow past this projection to blow the whistle. If the length of this projection is materially reduced, or if its fit is too loose, very slight reductions of signal line pressure, or even the vibration of the valve itself, such as would be brought about by the engine running over rail joints, might cause the sounding of the signal.

In order to more closely approximate actual service conditions, the manufacturers have investigated the operation of signal valves with a certain specified orifice, venting to the atmosphere at all times, to represent the leakage. The results of the tests show that in order to affect the signal valve operation at all, leakage must be excessive and above the amount which should be permitted in service, and it has therefore been concluded that a test involving leakage is unnecessary and of no practical value.

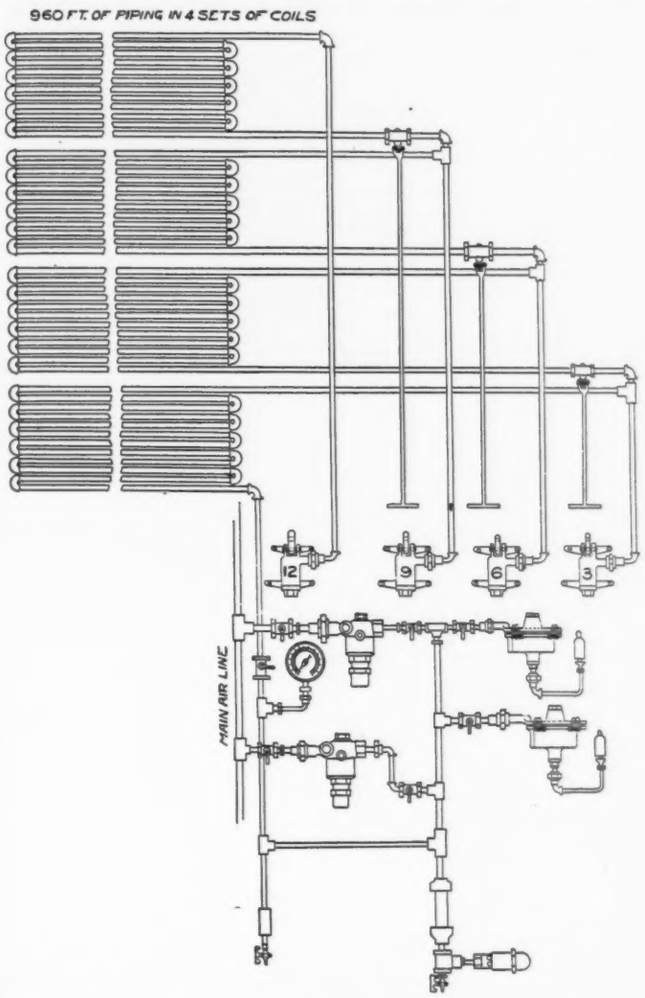
The manufacturers' signal valve test rack consists of sufficient piping to represent 20 passenger cars, accompanied by the proper piping, air signal reducing valve, air signal valve and air whistle the same as used in service, the signal reducing valve being set at 40 lb. The following method is followed in testing a 15-car train, a 10-car train and a 2-car train. The cock on the rear end of the last car must be closed at all times, and all other connecting cocks must be open, the system being charged to 40 lb.

Assemble the signal valve on the rack, and slowly cut it in. After the valve is charged, and before the whistle is assembled on the rack, make several reductions with the discharge valve on car No. 1, to properly seat the valve stem. After the valve is recharged, coat the connection to the whistle with soap suds to determine if leakage exists past the valve. After completing this test, assemble the whistle on the valve.

First, test the signal valve on a 15-car train. With the system fully charged to 40 lb., and all the connecting cocks open, make five reductions with the discharge valve on the fifteenth car, each reduction to be made by holding the discharge valve fully open for one second, allowing 1¼ seconds between the reductions. Following each reduction, the whistle must give one distinct blast. If, during this test, or any of the following tests, the whistles give two short blasts after one reduction, it indicates that the valve stem is too short or the diaphragm is too weak, requiring too light a difference in pressure to raise it. If one long blast is obtained, or the whistle does not stop blowing between the reductions, it indicates that the valve stem has excessive friction, which may be caused by either the valve stem or the diaphragm.

Before commencing reductions in the succeeding test, the signal line pressure must be charged to 40 lb. Then repeat the tests on the eighth and first cars. Next, test the signal valve on a 10-car train by closing the cock on the rear end of the tenth car, and repeat the above test on the tenth, sixth and first cars, after which, test the signal valve on a 2-car train by closing the cock on the rear end of the second car and make the above test on the first car. After the test, coat the entire valve with soap suds to detect porous castings.

Where trouble is experienced with false signals being transmitted while the train is running, a recording gage should be attached to the signal line, and if the corresponding reductions are not shown on the chart, it is generally found that the signal valve on the locomotive is too sensitive. The valve should be removed from the locomotive and tested on a suitable rack. The illustration shows a 12-car test rack used at Elizabethport shops,




**Twelve-Car Signal Valve Test Rack, Elizabethport Shops, Central Railroad of New Jersey**

C. R. R. of N. J., where all valves for the entire road are tested after repairs are made.

The report is signed by: L. N. Armstrong (Penn.), and H. L Sandhas.

DISCUSSION

The consensus of opinion in regard to the pneumatic signal was that in its present state it is not an absolutely reliable device. On trains of 25 to 30 cars in length considerable trouble is experienced with leakage, and in some cases trouble has been experienced with 16 to 18 cars. Where trains are of such a length it was believed expedient to increase the signal train line pressure to 60 lb. Greater care should also be taken in the proper maintenance of the present pneumatic system. On some roads no engine is allowed to depart from the terminal without the signal system being in satisfactory operation, while on others a system has been adopted where in case the pneumatic signal becomes inoperative the conductor shall make use of the conductor's valve and hand signals. Some roads have found that with the ⅛-in. choke opening in the signal line the leakage may more readily be determined, without interfering with the correct operation of the signal. In some cases it is found necessary to clean the signal valve as often as once a week. Mr. Armstrong, in closing his paper, stated that electric energy sufficient to operate an electro-pneumatic signal system could be obtained from dry cells or from the electric lighting system on the cars or locomotive.

## 100 PER CENT OPERATIVE BRAKES IN FREIGHT SERVICE

The general opinion is that an operative brake is one in which the piston moves out of the brake cylinder far enough to close the leakage groove, and not more than 10 in. when a full service brake application is made from at least a 70-lb. brake pipe pressure, remains so until the usual inspection is made, and releases properly in the usual methods resorted to in making ordinary terminal tests; the only other requirement is that the foundation brake gear be connected throughout to bring the shoes to the wheels. The second consideration is the question of what constitutes 100 per cent operative brakes. Our opinion in this respect contemplates that each brake in a train be operative as above stated and so connected that they may all be operated from the locomotive. This will constitute 100 per cent operative and meet all the requirements but one, namely, efficiency. The highest efficiency required to meet general conditions is that the train may be controlled by the engineer without the assistance of trainmen with the ordinary hand brake.

Unfortunately, while the requirements of efficiency reduce the difficulty of providing an operative brake, they also result in ability to control trains with a low individual brake efficiency throughout the train or a small percentage of brakes operative for service requirements, while certain other conditions automatically increase the necessary efficiency and number of operative brakes, and the greater the number of cars involved, the more pronounced are these results. The introduction of the yard pressure lines where trains are made up sufficiently in advance of leaving time, would give an opportunity to make the brake inspection and correct many defects before the engine was placed on the train for departure.

Any one point on a large system attempting to run 100 per cent operative brakes would be immediately confronted with a prohibitive number of cars with inoperative brakes and a congestion that would cause serious delays resulting in this particular point being criticized for tying up traffic. Relief for this particular terminal could only be brought about by allowing inoperative brakes to proceed, or by increasing the amount of the brake work done at the terminals on either side. It can readily be seen that any one railroad attempting to run 100 per cent operative brakes would be placed in almost the same position as the terminal above mentioned, and the same rule in regard to relief would apply between the railroads involved.

The difficulty of establishing the practice of cleaning brakes on cars in trains at large terminals where the tracks extend over a large territory is expensive, as it is hard to get men and material to the cars and men are idle a large part of their time. But again we find that at many small terminals where very little switching is done on the train outside of changing engines and cabooses, and where the repair track is close to the train yard, that air brake repairs can be made in trains successfully and economically, as the men in this case can be used on the repair tracks when no trains are in the yard. Yard air lines at these terminals are necessary to test out work of this kind and additional time allowed to trains in terminals to give the car men an opportunity to do the work before, or after, the train is switched. Yard train testing devices must also be provided at terminals in order that cars arriving in trains with brakes "cut out" may be tested to ascertain what, if anything, is wrong, and to test work on the brakes after it is completed.

After the facilities and materials are provided, then comes the proposition of procuring men who are competent and reliable to do the work or men who can be educated in a reasonable length

of time. The better supervision we have, the less trouble we have from this source. One of the conditions we find it hard to overcome is the careless manner in which some of the air brake work is done.

A system must be inaugurated to catch the disabled brakes as soon as practicable after the defect becomes apparent. With this in view, what might be called "dead lines" should be designated at reasonable distances over the road—terminals where facilities are the best, as 100 per cent points where no brakes that are inoperative are allowed to pass, regardless of lading. At all terminals where there are facilities, dead freight loads and empty cars with inoperative brakes should be caught and repaired. All cars on repair tracks should have their brakes carefully tested, and if the cleaning date is over nine months old on home cars, the brakes should be cleaned. This would avoid the necessity of putting the car on the repair track again in so short a time, and when it might possibly contain an important load.

If we wait until the trains are made up in the yard to make inspections we will have delays and bad cars, but if we require the men on all incoming trains to have the train fully charged and then make the required application of brakes before cutting off, the air brake inspection can be made at the time of usual train inspection, and any cars "bad ordered" can be switched out in the usual switching time.

The question arises as to what is to be gained by increasing the number of operative brakes. One reason is to provide a wider margin of safety by the ability to stop in a shorter distance in cases of emergency. The reason more frequently encountered, however, is the resultant reduction of slack action in long trains, which contributes largely to troubles arising from break-in-twos.

The report is signed by: Geo. H. Wood (A. T. & S. F.), and S. C. Wheeler (C. B. & Q.).

DISCUSSION

F. B. Farmer, of the Westinghouse Air Brake Company, strongly recommended the employment of a general car brake inspector for the purpose of instructing and demonstrating to the cleaners of the freight car air brake equipment how they should do their work, and to check them in their work. He also spoke strongly in favor of the incoming tests of the brakes in order that the defects may be located and corrected while there was sufficient time to do so. This will eliminate a lot of trouble and delay that would ordinarily be caused when the brakes are found defective on the outgoing tests. He also spoke of the tendency for some of the comparatively level roads to absolutely neglect the maintenance of the retaining valves. This causes a great deal of trouble for the roads receiving such cars in the mountainous districts, and greatly interferes with the expeditious transportation. He was strongly in favor of the "dead line" as described in the paper, and stated that at one point on a large road that operated this dead line system 75 per cent of the brakes cleaned had not run over nine months, showing that this work is not always done as carefully as it should be. Lack of knowledge and hurried work have been a great factor in the improper maintenance of brakes, and oftentimes are the basis for charges of dishonesty in doing the work.

Some roads are having very good success with carding freight cars with inoperative brakes, permitting them to go without tying up the train and having the work done at the next terminal. The trainmen have also been instructed to place defect cards on the cars as they become inoperative on the line, and also those cars that are picked up enroute. Trouble has also been experienced in using shop line pressure in testing the air brakes on the rip track, as many cases were found that where the brakes would operate under this high pressure they would not operate when on the train under a pressure of 70 lb. To overcome this the Louisville & Nashville has in use a device for reducing this pressure to the proper amount. One member strongly objected to the practice followed by many roads in allowing the man that cleans the triple valves to test them, as when this work is done piece work the men art apt to pass valves that are not in proper condition.

Walter V. Turner, chief engineer of the Westinghouse Air Brake Company, encouraged the men to do all in their power to influence their superiors to give them the proper facilities for keeping the brakes in the necessary good condition. Persistence and nerve in carrying out what they believe to be absolutely necessary in the maintenance of brakes is required to get the right results.

Mr. Wood, in closing the paper, believed that brake cylinder conditions should be more carefully watched, and also called attention to the large number of triple valves that were found defective after having only run for about six months. All air brake work should be given careful supervision and checking before it is permitted to pass out of the repair yards.

## HAND BRAKES ON HEAVY PASSENGER CARS

No scheme of hand brake control for heavy passenger cars presented for consideration appears to be entirely satisfactory. As the weight of passenger equipment cars increases, the desired braking power can only be obtained by increasing the hand leverage. Hence, where the desired hand brake power is provided through a sufficiently high muliplier of the leverage, there is introduced the objectionable feature of loss of time in winding up the long hand brake chain necessary to take up the slack and bring the shoes against the wheels. Because of this it has not been found an easy matter to provide a winding shaft or barrel of requisite capacity to accommodate the chain satisfactorily with the different amounts of slack or of piston travel existing.

It is generally recognized that time, as well as power, is an important factor in hand brake operation, and with this in view designs of hand brakes have been gotten out with the object of providing a quick take-up of the slack and then of increasing rapidly the leverage so that adequate shoe pressure may be supplied. Arrangements of this character have been satisfactory in a degree, but because of the variations in brake shoe wear and slack, the point on the winding cone at which the free slack is taken up is not always the one at which the desired higher leverage is obtained.

The difficulty in the way of satisfactory single truck operation appears to be one method of connecting the hand brake lever to the cylinder lever pull rod so that when the hand brake is being operated the air brake cylinder levers need not be moved. Some experimental designs of single truck hand brakes now on trial have sufficient merit to warrant further development.

It appears that in designing a hand brake gear for heavy passenger cars effort only should be made to provide power sufficient to enable switching crews to control them in yard movements.

The report is signed by: John P. Kelly; C. W. Martin (Penn.); L. P. Streeter (Ill. Cent.), and F. J. Barry (N. Y. O. & W.).

## RECOMMENDED PRACTICE

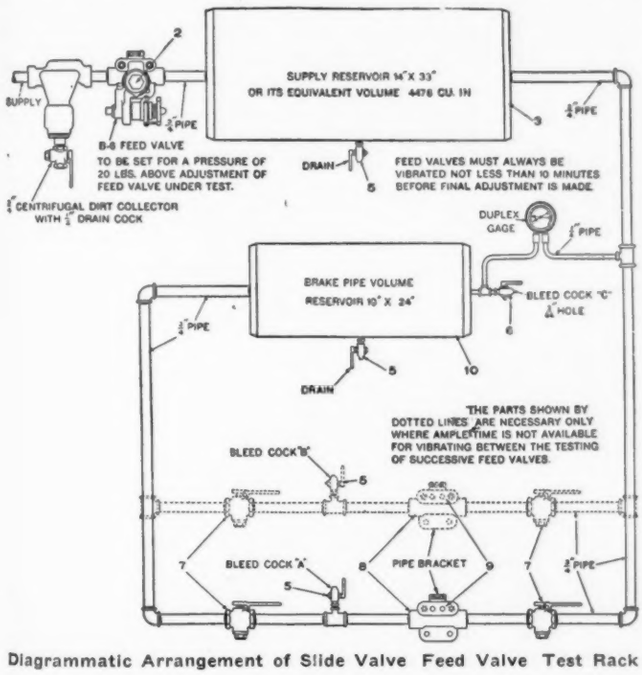
Aside from typographical and other corrections made to conform with the M. C. B. standards and recommended practices, it was recommended that the capacity of main reservoirs for passenger and switch engines should be not less than 40,000 cu. in., and for freight engines not less than 60,000 cu. in., an increase of not less than 25 per cent above these figures being desirable when the air compressor displacement capacity is 120 cu. ft. or more per minute. It was also recommended that main reservoirs should be tested with the hammer test with no pressure in the reservoir and followed with a hydrostatic test, using a pressure equal to 150 per cent of the maximum working air pressure, the hammer test to be made each time the engine receives general repairs, and the hydrostatic test to be made once a year.

Under the heading of "Tests for Feed Valves," it was recommended that feed valves should be tested and removed from service if they are not sufficiently sensitive to open with a maximum difference in pressure of 2 lb., with a brake pipe leakage of from 7 to 10 lb. per minute. The following test was also

recommended for all feed valves after they have been cleaned or repaired, the test rack shown in the illustration being the standard slide valve, feed valve test rack:

*Test No. 1.*—After applying the feed valve to the rack with its spring box and diaphragm removed, open cock *C* and 7, and close cocks *A* and 7 (shown at the left). Regulating valve leakage can then be noted as one end of the valve is exposed. If the supply valve is leaking it will be indicated by the discharge at the port on one side of the regulating valve stem in the recess under the diaphragm. In case of leakage at the latter port, make sure it is not between the two ports across the feed valve gasket as the effect is the same as with a leaky supply valve. Test the two cap nuts with soap suds. No leakage existing, or having been remedied, close cock 7 (shown at the right); replace the parts removed; open cocks (shown at the right) and *A;* and then tighten up on the regulating nut, previously left slack until the valve begins to vibrate rapidly. This will be shown by intermittent puffs of air at cock *A*. If the piston or its bushing are new allow the valve to vibrate for at least 10 minutes, then proceed.

*Test No. 2.*—Close bleed cocks *A* and *C;* open cock 7 (shown at the left), and adjust feed valve to the desired pressure. With brake pipe volume fully charged, open bleed cock *C* and note the


SUPPLY RESERVOIR 14" X 33"
OR ITS EQUIVALENT VOLUME 4476 CU. IN.
SUPPLY
B-6 FEED VALVE
TO BE SET FOR A PRESSURE OF 20 LBS. ABOVE ADJUSTMENT OF FEED VALVE UNDER TEST.
CENTRIFUGAL DIRT COLLECTOR WITH DRAIN COCK
DRAIN
FEED VALVES MUST ALWAYS BE VIBRATED NOT LESS THAN 10 MINUTES BEFORE FINAL ADJUSTMENT IS MADE.
DUPLEX GAGE
BRAKE PIPE VOLUME RESERVOIR 10" X 24"
BLEED COCK "C" 1/4" HOLE
THE PARTS SHOWN BY DOTTED LINES ARE NECESSARY ONLY WHERE AMPLE TIME IS NOT AVAILABLE FOR VIBRATING BETWEEN THE TESTING OF SUCCESSIVE FEED VALVES.
BLEED COCK "B"
BLEED COCK "A"
PIPE BRACKET
PIPE

**Diagrammatic Arrangement of Slide Valve Feed Valve Test Rack**

drop in pressure required to open the feed valve. It should be less than 2 lb. Also when the feed valve opens note whether the pressure in the brake pipe volume is promptly restored to the original amount, as it should be.

If the drop is 2 lb. or more and is restored promptly it indicates a tight piston or other undue friction. If the drop in pressure is 2 lb. or more before the feed valve opens and the pressure then remains practically constant at this lower pressure, the piston is too loose in its cylinder. A wider variation than the standard limit between the opening and closing points of the feed valve may be caused by the diaphragm spindle of the regulating portion, which guides the regulating spring, binding considerably at any point. Such resistance aids the regulating spring when the pressure is nearing the closing point of the feed valve and resists the action of this spring when a falling pressure should cause the feed valve to open.

*Test No. 3.*—With the brake pipe volume charged and the bleed cocks *A* and *C* closed, close cock 7 (shown at the right); reduce the brake pipe pressure 5 lb. below the setting of the feed valve, using bleed cock *A;* then, first being sure that there is 20 lb. excess pressure, open cock 7 (shown at the right) quickly and note the overcharge of brake pipe pressure. This must not be more than 2 lb. If the overcharge exceeds 2 lb., the piston fit is too close or the piston is oil or water packed. Wipe the piston and its cylinder dry and test again before making the piston a looser fit.

The report is signed by: S. G. Down (W. A. B. Co.); G. R. Parker (G. N.); H. A. Wahlert (W. A. B. Co.); J. R. Alexander (Penn.), and N. A. Campbell (N. Y. A. B. Co.).

OTHER BUSINESS

During the convention an afternon was given to the air brake appliance supply men, who talked to the members concerning their products. On Thursday afternoon the association was addressed by Walter V. Turner, of the Westinghouse Air Brake Company; N. A. Campbell, of the New York Air Brake Company, and J. R. Snyder, of the Pittsburgh Air Brake Company. Mr. Turner spoke of the developments during the past year, and told how the New York subway had increased its capacity by the adoption of the electro-pneumatic brake. Mr. Campbell gave an illustrated talk on the New York electro-pneumatic brake. Mr. Snyder gave an illustrated talk on the new air brake equipment furnished by his company.

The association was also addressed by E. H. De Groot, Jr., superintendent of transportation, Chicago & Eastern Illinois, and M. H. Haig, mechanical engineer, Atchison, Topeka & Santa Fe.

The following officers were elected for the ensuing year: President, J. T. Slattery, Denver & Rio Grande; first vice-president, T. W. Dow, Erie Railroad; second vice-president, C. H. Weaver, New York Central lines west of Buffalo; third vice-president, C. W. Martin, Pennsylvania Railroad; secretary, F. M. Nellis, Westinghouse Air Brake Company; treasurer, Otto Best, Nathan Manufacturing Company. The executive committee is as follows: T. F. Lyons, New York Central lines west of Buffalo; J. F. Barry, New York, Ontario & Western; L. P. Streeter, Illinois Central; Mark Purcell, Northern Pacific; G. H. Wood, Atchison, Topeka & Santa Fe.

It was voted to hold the next annual convention at Atlanta, Ga., on May 2 to 5, inclusive.

## STEEL PASSENGER TRAIN EQUIPMENT

To ascertain the progress of the building of steel and steel underframe passenger equipment and to develop the cost of reconstruction in steel of the present wooden passenger equipment in the country, the Special Committee on Relations of Railway Operation to Legislation issued a circular letter to the railways on January 2, 1915. Replies have been received from 284 companies operating 245,721 miles in the United States, and 62,112 passenger equipment vehicles, with 956 under construction on January 1, 1915. The tabulations based on these replies have been published in Bulletin No. 67, showing that of the cars under construction on January 1, 725 were all-steel, 228 steel underframe and 3 wood, and of the 4,495 cars acquired in the calendar year 1914, 3,355 were all-steel, 940 steel underframe and 200 wood, including 56 cars purchased second hand. Of the total number of passenger train cars in service on December 31, 1914, 12,900 were all-steel, 5,700 steel underframe and 43,512 were wood. The character of the various classes of equipment in service on December 31, 1914, is shown in the following table:

| | Steel | Steel underframe | Wood |
|---|---|---|---|
| Postal | 888 | 217 | 461 |
| Mail and baggage | 668 | 404 | 2,562 |
| Mail, baggage and passenger | 31 | 56 | 579 |
| Baggage and passenger | 528 | 227 | 3,519 |
| Baggage or express | 1,478 | 1,315 | 7,507 |
| Passenger | 5,105 | 1,704 | 22,266 |
| Parlor, sleeping and dining | 3,200 | 1,526 | 5,353 |
| Business | 32 | 109 | 730 |
| Motor | 970 | 142 | 535 |
| Total United States | 12,900 | 5,700 | 43,512 |

A table is also given in the bulletin showing that for the cars acquired during the past six years the percentage of all-

steel cars has increased from 26 to 74.6, while the percentage of steel underframe cars has ranged from 14.8 per cent to 30.4 per cent, and was 20.9 per cent in 1914. The percentage of wooden cars has decreased steadily from 51.4 per cent in 1909 to 4.5 per cent in 1914.

Another table shows that the number of all-steel cars in service has grown from 629 in 1909, an increase of 1,951 per cent, while the number of steel underframe cars has grown from 673, an increase of 747 per cent. A total of 4,614 wooden cars has been retired in three years. Of this number 1,048 were retired during the calendar year 1914. The bulletin also gives the following table showing the approximate cost of replacement of wooden cars:

Approximate Cost of Replacement of Wooden Cars

| | Number | Average cost | Amount |
|---|---|---|---|
| Postal | 461 | $11,000 | $5,071,000 |
| Mail and baggage | 2,562 | 10,000 | 25,620,000 |
| Mail, baggage and passenger | 579 | 10,000 | 5,790,000 |
| Baggage and passenger | 3,519 | 10,000 | 35,190,000 |
| Baggage or express | 7,507 | 8,500 | 63,809,500 |
| Passenger | 22,266 | 12,800 | 285,004,800 |
| Parlor, sleeping, dining | 5,353 | 22,000 | 117,766,000 |
| Business | 730 | 15,000 | 10,950,000 |
| Motor | 535 | 20,000 | 10,700,000 |
| Total | 43,512 | | $559,901,900 |
| Annual interest charge at 5 per cent | | | $ 27,995,095 |

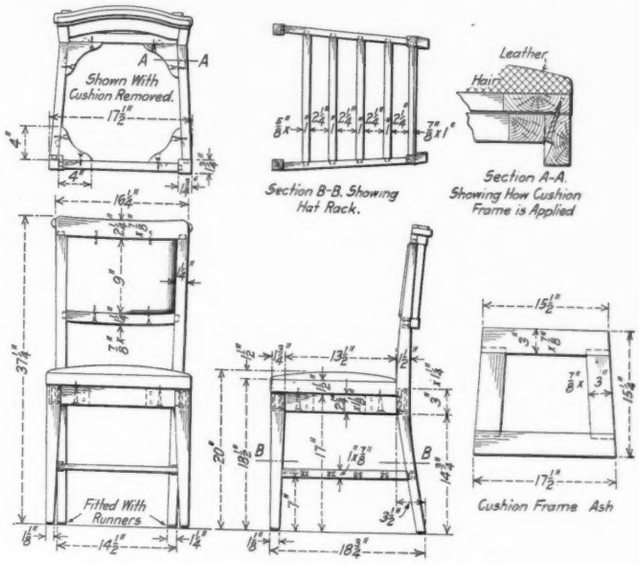
The charge to operating expenses under the classification accounts of the Interstate Commerce Commission, assuming a value of $4,000 per vehicle replaced, would be $174,048,000.

Replies were also received from 10 companies operating 27,628 miles in Canada, showing that of a total of 5,366 passenger train cars in service on December 31, 1914, 79 were all-steel, 187 steel underframe and 5,100 were wood. Of 57 cars under construction on December 31, 38 were all-steel, 16 steel underframe and 3 wood.

## DINING CAR CHAIRS

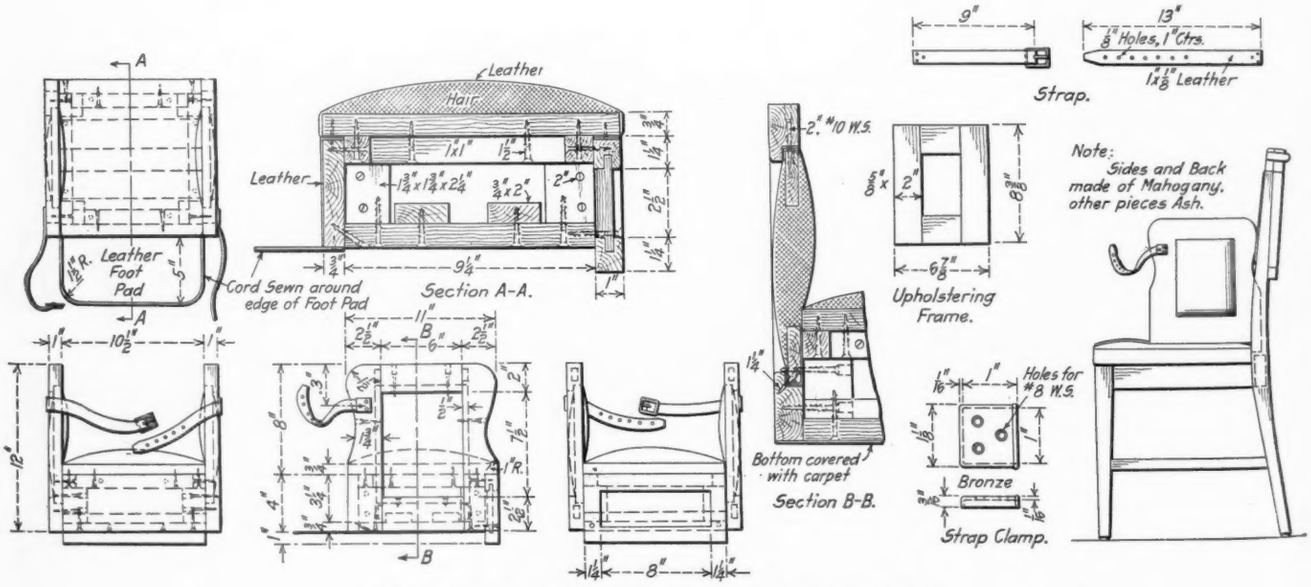
For five years the Canadian Northern has been experimenting to obtain a satisfactory design of chair for use in dining cars. Out of seven different designs tried out in service during this period the one shown in the engraving has met with marked success and has proved much more satisfactory than any of the others.

The principal weakness in most chairs is the difficulty of keeping the frames from racking loose. This has been overcome in the Canadian Northern design by bracing the legs by means of the hat rack shown in the illustrations. This has been found to overcome the difficulty of the frame loosening and is also appreciated by passengers, as it avoids the necessity of reaching over the heads of others in order to place their hats on the overhead hooks and to remove them when leaving the car. Spring cushions have been eliminated, as it has been found that they are expensive to maintain. The absence of gimp is also noteworthy, the leather being simply folded in, making a clean, smooth surface. These chairs have so far not needed any repairs and are both light and substantial.




Canadian Northern Dining Car Chair

The child's chair shown replaces the usual high cushion and has been favorably received by patrons of the road. As shown in the engraving, it consists of a box or frame upholstered in leather, and with two side pieces and a leather foot pad. The chair is placed on the seat of one of the ordinary dining chairs, the back of which forms the back of the combined chair. The designs for these chairs were worked out by A. L. Graburn, mechanical engineer of the Canadian Northern, Toronto, Ont.

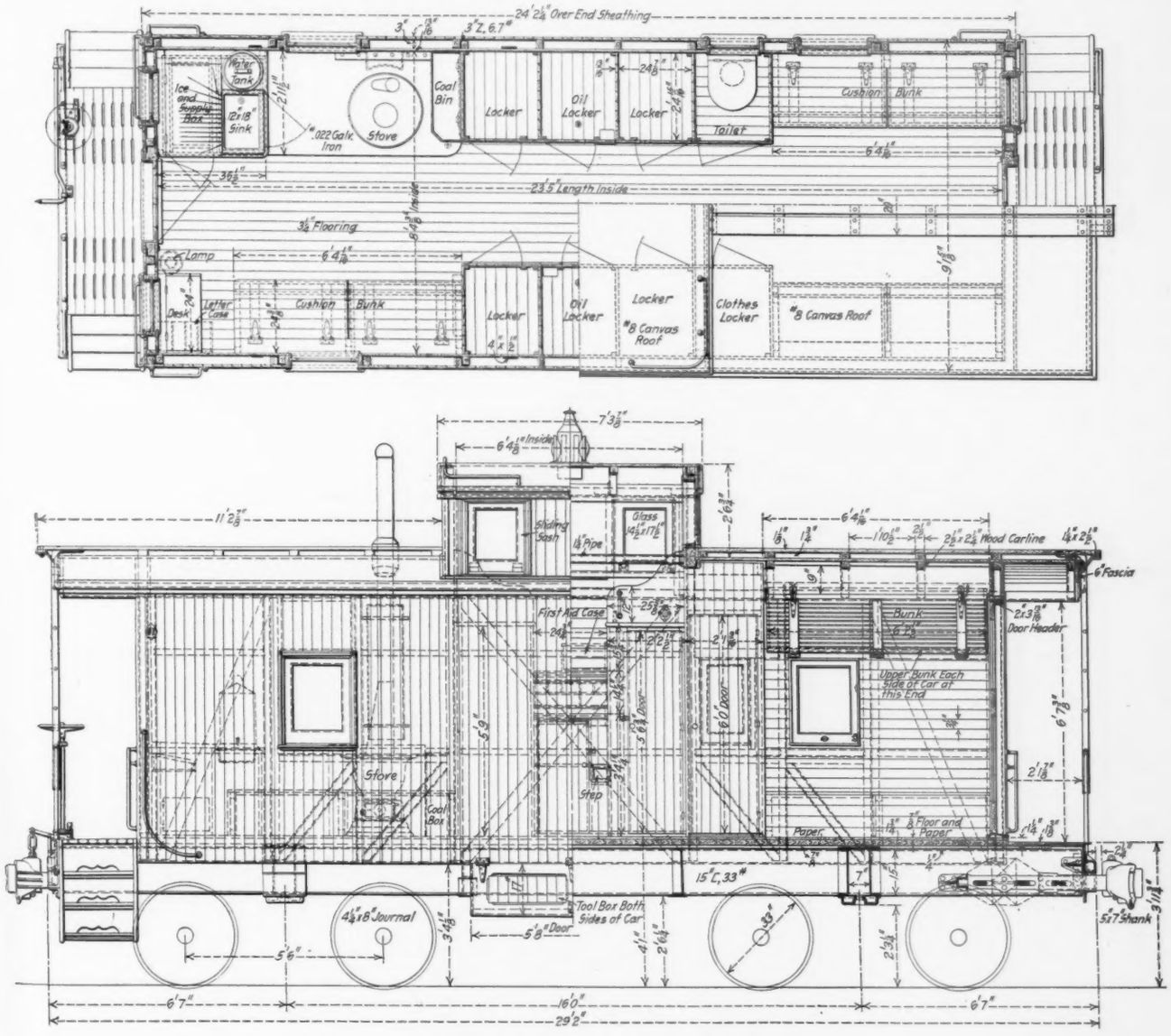



Child's Chair Used in Dining Cars on the Canadian Northern

# STEEL FRAME DOUBLE TRUCK CABOOSE

## Underframe of Exceptionally Heavy Design; Comfort and Convenience of Crew Carefully Considered

About a year ago the Buffalo, Rochester & Pittsburgh built an eight-wheel steel frame caboose at its Du Bois shops, which was placed in service to thoroughly test the design before adopting it as standard. In preparing the design trainmen were consulted by the mechanical and operating officers in order that everything requisite to the comfort and convenience of the crew might be embodied in the car. The results obtained in service have been highly gratifying and the riding qualities have been found exceptionally good. The car has a total length over the couplers of 31 ft. 7 in., and has platforms about 2 ft. 2 in. in width. The finished interior has a length of 23 ft. 5 in. and is 8 ft. 4⅜ in. wide. The car weighs 37,900 lb.




**Part-Sectional Views of the Finished Caboose**

Special attention was given to the interior arrangement of the car, which is provided with sleeping accommodations for five persons in three lower and two upper swinging bunks. Two additional persons may also be accommodated in the cupola. The arrangement of the upper bunks is similar to that employed in sleeping cars; when they are not in use they may be swung up against the roof of the car thus leaving the side windows entirely unobstructed. There is a desk and pigeon holes for letters and other stationery, an ice-box with separate food chamber, a sink, a cupboard and large water cooler, a stove and coal box, a toilet room and lockers for clothing, oil cans and lanterns. Special holders are provided for torpedoes, fusees, lantern globes and markers. A pressure gage is attached to the pipe leading to the conductor's valve, both being conveniently accessible either from the cupola or the floor of the caboose.

### UNDERFRAME

The underframe is of exceptionally rigid construction for a car of this nature. The center sills are 15-in., 30-lb. channels spaced 12⅞ in. back to back and extend continuously between the platform end sills. They are 28 ft. 6 in. in length and are provided with a ¼ in. top cover plate between points 11 in. back

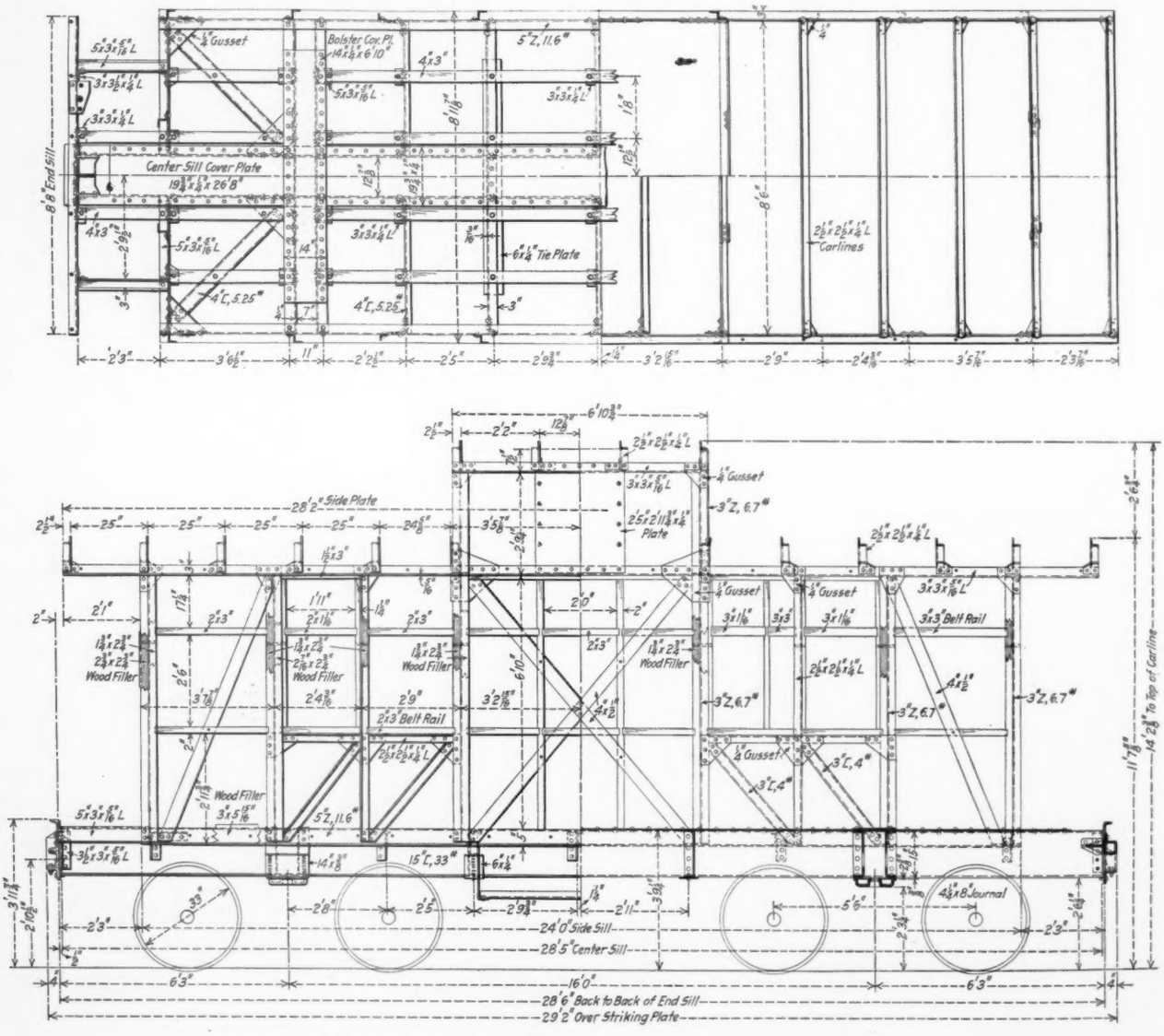
of the platform ends of the sill. The body bolsters are spaced 16 ft. between centers and are built up of two ¼-in. pressed steel sections with pressed steel fillers between the center sills, and top and bottom cover plates. The top cover plate is of ¼ in. steel 14 in. wide and is 6 ft. 10 in. long. A ⅜ in. plate is riveted to the bottom flanges, terminating just outside of the side bearings.

The side sills are 5-in., 11.6 Z-bars, 24 ft. in length, placed with the bottom flanges out. They are secured to the ends of the bolsters and to 3/16 in. pressed steel crossties located 2 ft. 11 in. on either side of the transverse center line. At the ends they are secured to 5 in. by 3 in. by 5/16 in. angles which form the body end sills. The corners of the car body are braced diagonally to the center sill and body bolster by 4-in., 5¼ lb. channels secured flanges downward to ¼ in. gusset plates at either end.

tom of the side plate is 6 ft. 10 in. above the top of the side sill, and it is extended to support the platform roof carlines.

The end panels of the side frame have single 4 in. by ½ in. plate diagonals, the lower ends of which are riveted to the side sills near the corner posts. Two diagonals of the same section are placed in the center panel, which has a total length of 6 ft. 5⅞ in. The intermediate panels contain the side windows. They are stiffened below the windows with longitudinal angles and channel diagonals. The angles are of 2½ in. by 2½ in. by ¼ in. section, and are secured to the posts by means of gusset plates, to which the upper ends of the 3-in., 4-lb. channels are also riveted.

The door posts are 3-in., 6.7-lb. Z-bars and are placed to clear 15 9/16 in. either side of the center line. At the bottom




**Half-Sectional Side Elevation and Plan of the Steel Caboose Frame**

Longitudinal platform sills of 5 in. by 3 in. by 5/16 in. angle section are placed between the platform end sill and the body end sill 2 ft. 9½ in. on either side of the center.

### BODY FRAMING

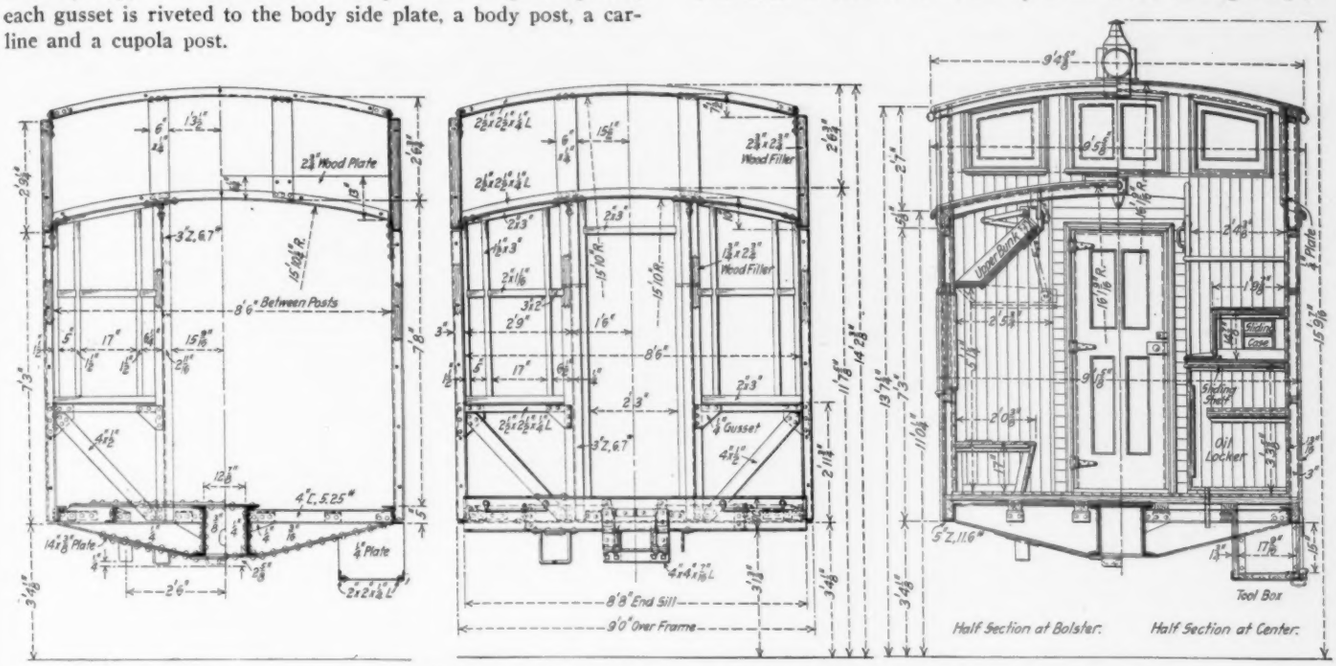
The side frame is made up of seven channels. The corner and side posts are 3-in., 6.7-lb. Z-bars, with two additional posts of 2½ in. by 2½ in. by ¼ in. angles on each side. They are secured directly to the side sills at the bottom, and by means of gusset plates to the 3 in. by 5/16 in. angle side plates. The bottom they are riveted directly to the body end sill and at the top are secured to a carline by angle connectors. Angle belt rails are placed between the door and corner posts at a height of 2 ft. 6¾ in. above the top of the side sills and 4 in. by ½ in. flat diagonals between the belt rails and the body end sill, the outer ends being at the top. This construction provides for window openings in the ends of the car.

The carlines are 2½ in. by 2½ in. by ¼ in. angles, formed to a radius of 15 ft. 10¼ in. They are secured to the side plates by gussets inside and the ends of their own flanges outside. The

cupola frame is made up of Z-bar posts and angle side plates and carlines, all of the same section as the similar members of the car body, to which it is secured by means of gusset plates; each gusset is riveted to the body side plate, a body post, a carline and a cupola post.

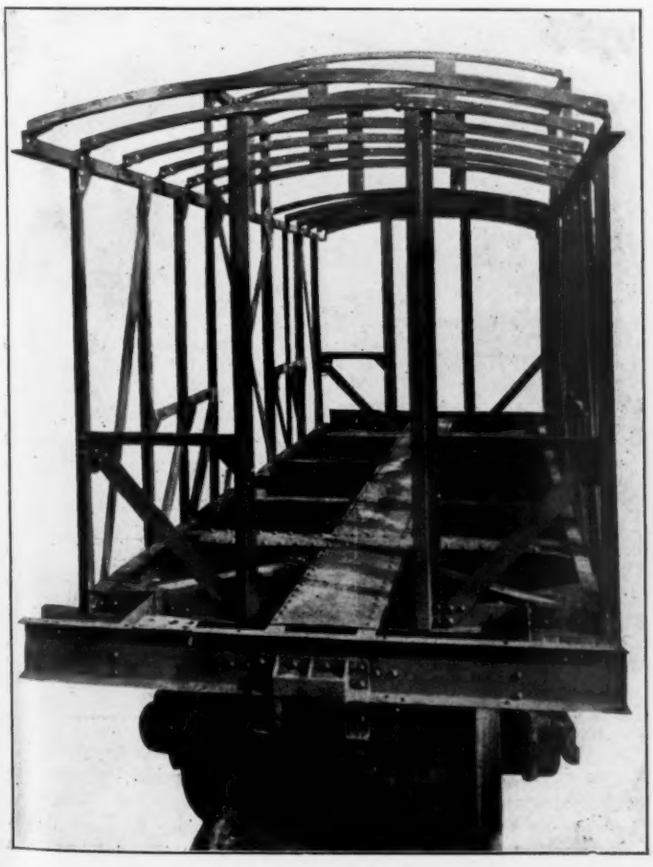
wood belt rails and vertical nailing strips are set into the frame and the sheathing secured to them.

The floor is secured to 4 in. by 3 in. wood nailing strips,

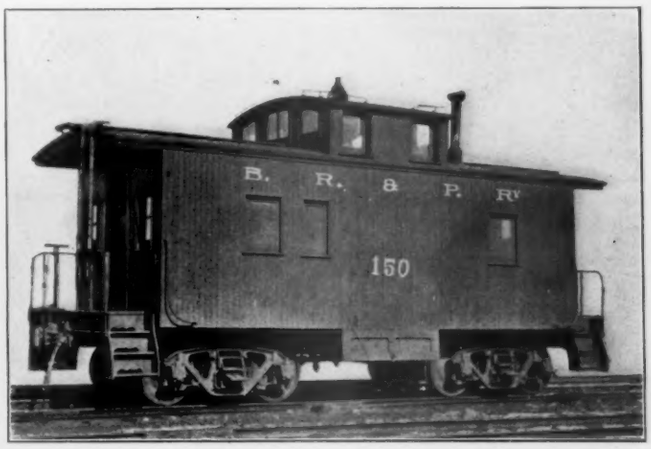



End and Cross-Sectional Elevations Showing the End Frame and Finished Interior of the B. R. & P. Caboose

The sheathing of the car both inside and outside is of wood. The question of finishing it entirely in steel was considered, but wood was finally chosen because of its better heat insulating qualities. As shown in the side elevation of the car frame, placed 12½ in. and 20 in. from the center line on either side. These strips are continuous between the bolsters, to which they are secured by 5 in. by 3 in. by 5/16 in. angle brackets. They are bolted directly to the flange of the pressed steel crossbearers. Additional support for the floor is furnished by three channel crossbearers on either side, brackets being riveted to them for bolting the nailing strips. Similar nailing strips are placed between the body bolster and the end of the car, those at the center extending through to the platform end sills, while the others terminate at the body end sills. The first course of



The Assembled Steel Frame of the B. R. & P. Caboose




Steel Frame Caboose for the Buffalo, Rochester & Pittsburgh

flooring is 1¼ in. thick and is laid on paper. Above this is placed another layer of paper on which is laid the top floor of ⅞-in. material running lengthwise of the car.

The roof is laid on 2½ in. by 2¼ in. wood carlines, which are bolted to the angle carlines. It consists of one thickness of wood sheathing covered with No. 8 canvas.

Tool boxes are placed under the center of the car on both sides. These are 5 ft. 8 in. in length by 17 9/16 in. in depth by

15 in. in height, and are closed by side doors which are hinged at the top. These boxes have a steel frame made up of ¼ in. end plates, which are flanged both top and bottom, and 2 in. by 2 in. by ¼ in. angles. The end plates are riveted at the top to the flange of the pressed steel crossties and are connected at the bottom by the angles. The bottom and back are closed with 1¾-in. plank, the front being closed by the door, which opens the entire length of the box.

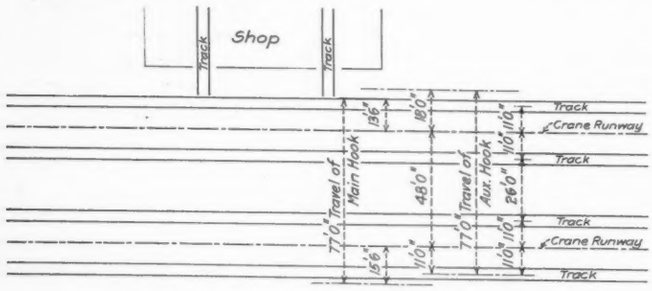
In order to secure an easy riding car a specially designed truck has been used. It has a wheelbase of 5 ft. 6 in. The side frames and bolsters are of cast steel and are fitted with long elliptic springs.

## PROPOSED GANTRY CRANE FOR CAR REPAIR YARDS

BY W. E. JOHNSTON
Chief Draftsman, Western Pacific, Sacramento, Cal.

Practically all machine, boiler and blacksmith shops are equipped with cranes of various kinds suited to their requirements, but the car repairers still do their hoisting by means of jacks which are comparatively slow and inefficient when the cost of labor to operate them is considered. There is, also, an element of danger always present in hoisting cars by means of jacks because of uncertain footing under the jacks.

The gantry crane described herein has been laid out as a




Plan of Car Repair Yard for Gantry Crane Service

suggestion for the provision of the same kind of hoisting and carrying facilities for the car repair tracks that have proved their value on other railroad repair work. The character of the work on repair tracks requires considerable space and the first problem is to make the equipment cover a large territory without becoming too expensive. Fairly high speed is essential, also, on account of the distances to be traveled.

The drawings show an arrangement that is believed to cover the requirements satisfactorily and at reasonable expense. The gantry crane with cantilever extensions would have a single trolley with two hoists and should fulfill about the following specifications:

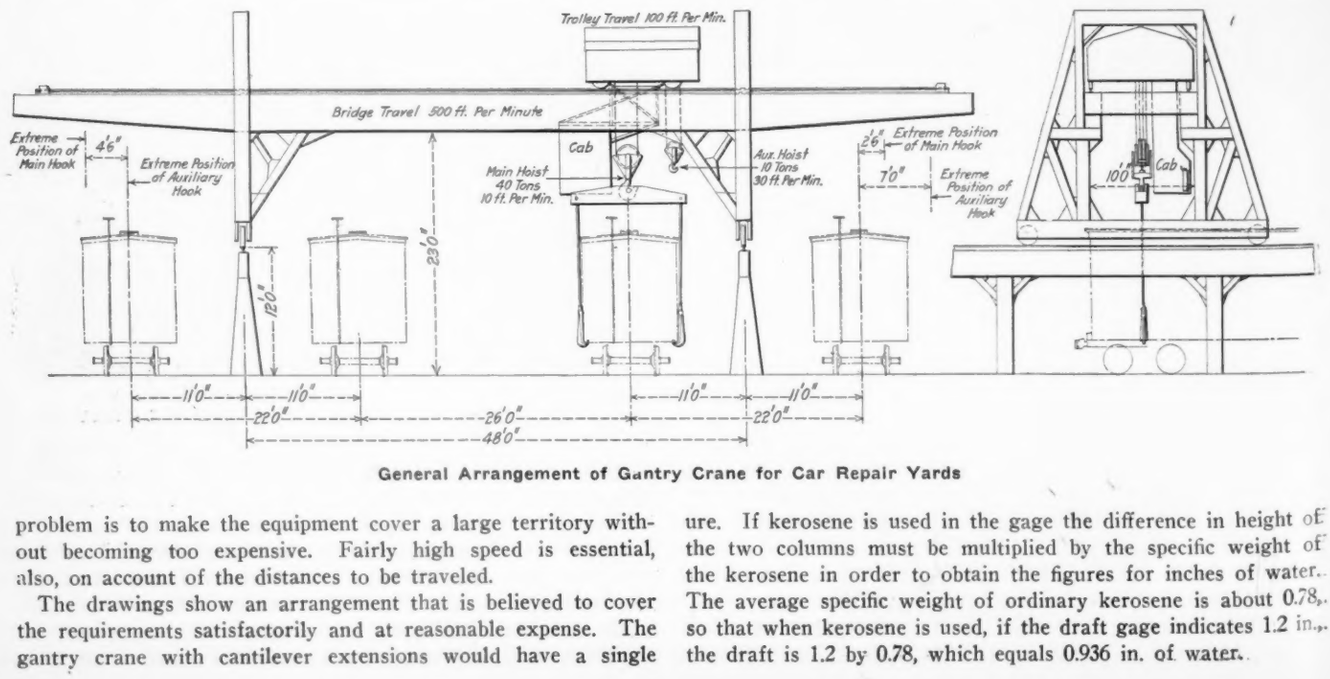
| | |
|---|---|
| Main hoist, capacity | 40 tons |
| Main hoist, speed | 10 ft. per min. |
| Auxiliary hoist, capacity | 10 tons |
| Auxiliary hoist, speed | 30 ft. per min. |
| Bridge travel | 500 ft. per min. |
| Trolley travel | 100 ft. per min. |

The main hoist would lift one end of any loaded car or, with proper grappling irons, would lift the entire body of any empty car, thereby eliminating the use of jacks for the purpose of raising the cars for the removal of trucks or for other purposes. The auxiliary hoist is intended for handling trucks, mounted wheels, couplers and other lighter parts.

On the track layout a shop is shown at the side of the tracks near the transverse center line of the yard. This is intended principally for mounting wheels, but could include any other metal working machinery desired for other repair work. By locating the shop near the center of the tracks the average distance traveled by the crane in handling material to and from the shop is reduced to a minimum.

With the crane and runway as shown, a complete truck or any smaller part could be picked up at any point and laid down at any other point within the space served by the crane. This would make it possible, for example, to remove an entire truck from its car and deliver it to the shop, where repairs could be made more conveniently and cheaply than in the yard.

In working out the design of the runway the requirements of safety were kept in mind as well as low cost. A high speed gantry crane running on a track at grade would be dangerous to men working in the vicinity and the crane itself would be liable to derailment from obstructions on the track. With the low runway as shown the rails are at such a height that they will always be clear and there is no occasion for injury to employees. This arrangement leaves the ground clear except for the columns supporting the runway.




General Arrangement of Gantry Crane for Car Repair Yards

Significance of the Word Draft.—The word "draft" as used in describing boiler practice is indefinite. Sometimes it signifies the motion of the gases, but ordinarily it means the difference in pressures which produces the motion. Thus, for example, if the difference in the water columns in the U-tube connected to the breeching is 1 in., the draft in the breeching is said to be 1 in. of water. Actually, of course, the pressure of the gases within the breeching is 1 in. of water below atmospheric pressure. If kerosene is used in the gage the difference in height of the two columns must be multiplied by the specific weight of the kerosene in order to obtain the figures for inches of water. The average specific weight of ordinary kerosene is about 0.78, so that when kerosene is used, if the draft gage indicates 1.2 in., the draft is 1.2 by 0.78, which equals 0.936 in. of water.

# SHOP PRACTICE

## GREAT NORTHERN RECLAMATION PLANT

The geographical location of a railroad governs to a large extent the practices to be followed in the reclamation of scrap material. Some roads find it to their advantage to concentrate the classifying, reclaiming and salvaging at one principal point on the system, while other roads salvage and reclaim a great amount of material at the various shop points, leaving the classifying to be done at the scrap docks. This latter practice the Great Northern has found it expedient to follow, owing to the number and location of its shops; and its shop men are so trained that but little usable material finds its way to the general scrap docks. Thus it is only necessary to classify the scrap, salvaging what material is picked up from the road, such as track material, wreckage, etc., which is brought directly to the scrap dock.

The bulk of the scrap is received at St. Cloud, Minn., 75 miles west of St. Paul, where it is sorted and held for shipment to the scrap dealers, with the exception of the wrought

Fig. 1—Scrap Pile at St. Cloud

iron scrap, which is salvaged or worked over into first class bar iron in the rolling mill at that point. On the extreme west end of the system the scrap is classified and sold direct to the mills in that vicinity. By following this plan a large amount of cross hauling of the reclaimed material is eliminated, the stores department is relieved of a large amount of accounting, since the material reclaimed is turned directly into the local stock, and the shops receive direct credit for the amount of material they reclaim.

While the company has met with marked success in operating on this basis the chief point of interest is the reworking of the wrought iron scrap at St. Cloud. At this point the company operates a full fledged rolling mill for this purpose, and since it was started in August, 1913, it has reworked all of the wrought scrap originating on the entire system at a substantial profit. During the year 1914 this mill produced 8,863,835 lb. of bar iron, divided into various classes as follows:

| | |
|---|---|
| Round iron, common | 6,326,865 lb. |
| Square iron, common | 42,780 lb. |
| Flat iron, common | 1,852,635 lb. |
| Deformed iron, common (for reinforced concrete) | 14,505 lb. |
| Hexagonal iron, refined | 91,480 lb. |
| Round iron, refined | 507,407 lb. |
| Flat iron, refined | 28,163 lb. |
| Total | 8,863,835 lb. |

This was done at a cost of less than 90 cents per 100 lb., on an average, this figure including the cost of the scrap at current prices and all overhead charges, and it is conservatively

Fig. 2—Wrought Iron Scrap Ready to Be Made Into Piles for the Rolling Mill

estimated that a saving of over 25 per cent has been made on the market price of the iron rolled.

The mill is operated as a distinct unit and is under the direct jurisdiction of the superintendent of motive power in charge of shops. All the work connected with it is done on a

Fig. 3—Piling Bench at St. Cloud Rolling Mill

contract basis, the standard rolling mill scale being followed consistently. The wrought scrap is sold to the mill by the stores department, as to an entirely independent concern, at the prevailing scrap prices, and the mill sells, as it were, direct to the stores department, charging for the material the

cost of production, which includes the scrap cost and all overhead charges. This price is carried in all the general price lists and is changed monthly. As the mill is able to supply the needs of the system there is no confusion with the outside market prices. The work of the mill is done on a shop order basis, the orders being issued by the stores department for a sufficient quantity to warrant the changing of the rolls.

The workmen in the mill are all experienced mill men, it being found quite desirable to obtain them from other mills rather than to attempt to educate the local men to do the work. The force consists of one head roller, who has charge of the mill and with whom the contracts are made, two

Fig. 4—Sheared Wrought Iron Axles Which Are to be Rolled into Refined Iron Bars

roughers, two stranders, two finishers, one catcher, one hooker-up (these men pass the heated bars through the rolls), two heaters, two helpers, two straighteners, two shear men and four pilers, all of whom are paid out of the contract price.

The scrap as it is received from the system is shown in Fig. 1. It is classified from this pile and delivered to the scrap bins, with the exception of the wrought iron scrap. The rods in good condition and of a diameter generally used at different points are cut to length, straightened and applied against any orders for such material. The wrought iron scrap which is not thus handled is cut to proper length for piling, sorted and delivered to the piling bench. Fig. 2 shows a pile of the smaller pieces just outside of the mill. As it is required it is shoveled through the window onto the piling

Fig. 6—Shop for Maintaining the Mill Rolls

bench shown in Fig. 3. Here it is made up into piles varying from 75 lb. to 250 lb. in weight. The flat iron is used for the sides and battens of the piles.

The wrought iron axles are sheared to length as shown in Fig. 4. This iron is rolled into what is known as the refined iron mentioned in the output table previously given. It is used for engine bolts, all rivets except those used in boiler work, and such other material as requires a better grade of iron The iron made from the piles is known as common iron. The piles are heated in two large oil furnaces of the reverberating type, each having a capacity of 1,900 lb. per heat. These furnaces are located in front of the rolls, one on each side, and each furnace is used in rotation; that is, while one is feeding the rolls the other is heating its charge to the

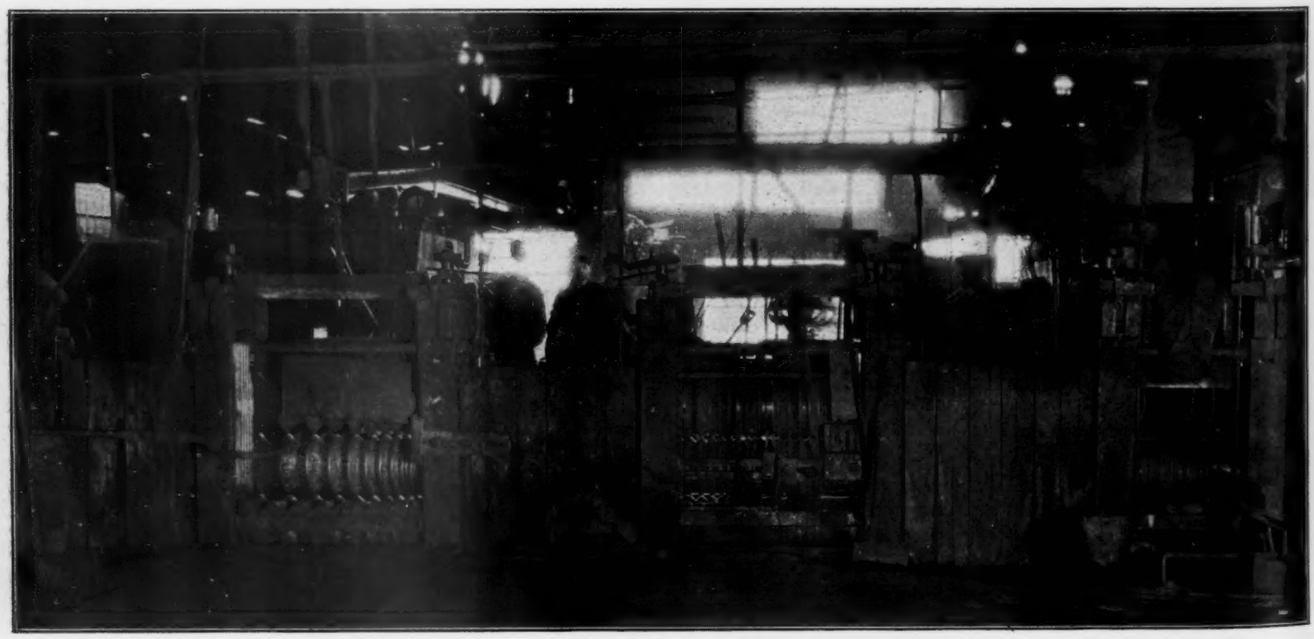


Fig. 5—Rear View of the Rolling Mill; Roughing Rolls on the Left

proper rolling heat. The heated piles are carried from the furnace to the mill, a rear view of which is shown in Fig. 5, by long tongs suspended from an overhead trolley which runs between the two furnaces and the roughing rolls shown on the left in the photograph.

The mill is what is known as a 12-in., three-stand mill, there being three sets of housings. The rolls in the different stands are connected by flexible couplings and the entire mill is driven by a 125-hp. Buckeye engine. The housings of the mill were built by the company and the rolls purchased from the United Engineering & Foundry Company, Pittsburgh, Pa. For the entire work of the plant 44 separate rolls are required. These are maintained in condition by a machinist, a special room being assigned to this purpose (see Fig. 6). The rolls are such that the following sizes of bars may be rolled:

| | |
|---|---|
| Round iron | ½ in. to 1⅞ in. |
| Square iron | ½ in. to 1½ in. |
| Hexagonal iron | ⅜ in. to 1⅜ in. |
| Flat iron | ¼ in. to 1 in. by 2 in. |
| | ⅜ in. to 1 in. by 1½ in. |
| | ⅜ in. to 1 in. by 1¾ in. |
| | ⅜ in. to 1 in. by 2 in. |
| | ⅜ in. to 1 in. by 2½ in. |
| | ⅜ in. to 1 in. by 3 in. |
| | ⅜ in. to 1 in. by 3½ in. |
| | ⅜ in. to 1 in. by 4 in. |
| | ½ in. by 1⅞ in. |

In addition to this, deformed iron is rolled for concrete reinforcing bars. All but the ½-in. round iron is rolled to size in one heat. This is made into billets in order to produce the necessary homogeneity of metal for the small bar.

As the finished bar comes from the rolls it is placed on a hot bed. Bars have been rolled as long as 200 ft. The maximum output made by the mill is 75,000 lb. for one day (a day is governed by the run of the heats) and 1,480,000 lb. for one month. The bars are taken from the hotbed while still hot, passed over a series of large diameter rollers and cut to length, usually 16 ft., on an alligator shear. They are then weighed on track scales and placed in stock as shown in Fig. 7. The refined iron is distinguished from the common iron by the use of red paint on the ends. Taken as a whole the mill occupies a space 250 ft. long by about 45 ft. wide.

With all this material collected at this point it has been found expedient to manufacture bolts, rivets and grab irons at St. Cloud for the entire system. During the year 1914 over 1,600,000 bolts were made at an average cost per 100 lb. of $1.20 without nuts, this cost including the cost of the iron as produced by the mill, labor and the necessary overhead expense. In addition to this 322,740 ½-in. carriage bolts were made at an average cost of $1.60 per 100 lb. without nuts. One hundred and seventy-six thousand rivets were also made at an average price of $1.25 per 100 lb. boxed. This latter item alone represents a saving of over 300 per cent. The bolts and rivets under 9 in. in length are made in an automatic Ajax bolt machine which is fed directly from a furnace handling the 16-ft. rods. This machine will produce on an average of 1,500 lb. of rivets per hour and 4,000 bolts. Fig. 8

Fig. 8—Carriage Bolts Made on Automatic Bolt Machines

Fig. 7—Storage Yard for Finished Bar Iron

shows some of the carriage bolts thus made. The bolts over 9 in. in length are made on a continuous motion bolt machine, which will produce 1,200 bolts per hour.

As stated in the first part of this article, the local shops do what reclaiming is possible. For instance, a group of machines is used in the freight car repair shop at St. Cloud for reclaiming the bolts and nuts taken from the cars under repairs. It consists of a four-head threading machine, a small shear and a six-spindle nut tapping machine. Those bolts and nuts that are found suitable for use are placed directly in bins in the shop for immediate use. Those bolts that are slightly damaged are sheared off, rethreaded and placed directly in the available stock, and the nuts that are badly rusted are tapped and also made available for immediate use. Large quantities of bolts are thus reclaimed with all the otherwise necessary accounting and trans-shipping eliminated.

In addition to the manufacture of bar iron at St. Cloud the Great Northern makes all of its heavy bar iron from 2 in. up to 12 in. square for the system at its Dale street, St. Paul, Minn., shops under a 4,000 lb. hammer. The scrap is made into piles of 250 lb. and hammered into slabs and held in stock for shop orders for heavy bar iron. This shop slabs 11,000 lb. per day. In cases of emergency the material is worked into driving axles. The company also maintains its brass foundry at this point, where all the brass scrap is received and used. This foundry provides the necessary brass castings for the entire system and has a capacity of 15 tons.

## LOCOMOTIVE BOILER INSPECTION

I don't quite agree with the very optimistic statement made by the chief of the Federal Boiler Inspection Bureau as to what his bureau has done. I hope he did it and I hope he will continue to do it, but there is an old Spanish proverb which states, "What has not happened for two years, may happen in two minutes." And it is quite correct.

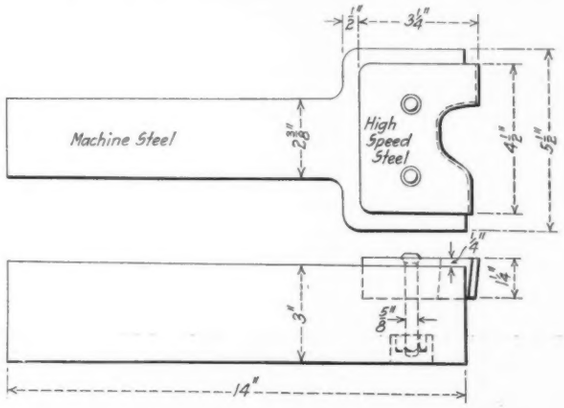
The Public Service Commission of the state of New York, whose members have had five years' experience in conducting a locomotive boiler inspection bureau, state in their report for 1913 that they doubt very much the wisdom of continuing the locomotive boiler inspection department, as the officers of the mechanical departments of the railways have so adequately performed their work that they do not see why it is necessary. And then they go on and show a tabulated statement as to the number of accidents before and after—really not before, but the first year, which can be assumed as being before the boiler inspection bureau was established, because any rules put into force had not had time to make a radical change in the conditions that had been in effect—and during five years from 1909, accidents were reported as follows: 1909, 12 accidents; 1910, 11 accidents; 1911, 36 accidents; 1912, 35 accidents, and 1913, 27 accidents. Now I do not for a minute mean to criticize the boiler inspection department of the federal commission. I am well acquainted with a number of the gentlemen connected therewith, and their work has been of the most meritorious character, but it is a question in my mind as to whether the public of the United States has gotten back the $225,000 paid those gentlemen for performing their work (which they earned) and whether they have gotten back the $6,600,000 paid by the railroads for improving a theoretical and not a practical condition. Do not misunderstand me; there has been improvement. The question is whether the improvement, or all of it, has been worth while. Another question is whether we cannot accomplish the same improvement with very much less documentary evidence. The Public Service Commission of New York remarked in the 1913 report, "The mass of correspondence reaching this office and the number of reports reaching the office is so great that we could not inspect the boilers."

The Federal Congress at 4 o'clock one morning passed a law extending the authority of the chief of the Division of Locomotive Boiler Inspection over the entire locomotive and its parts. If the gentlemen who advocated that law know what it means, they know more than any railroad man in the United States.—*D. F. Crawford, general superintendent of motive power, Pennsylvania Lines West, before the Pittsburgh Railway Club.*

## DOUBLE TIRE FLANGING TOOL

BY R. E. BROWN
Machine Shop Foreman, Atlantic Coast Line, Waycross, Ga.

In a large number of shops the driving and car wheel lathes were built before the advent of high-speed steels made necessary by the rigid construction found in modern machine tools. These old machines are too light to permit the use of flanging tools cutting on both sides of the flange at the same time, and the tool shown in the drawing was designed in order that the operator might be able to finish flanges under such conditions




Flanging Tool for Light Wheel Lathes

without removing and replacing the tool holder in the tool post. The contour of the tool is correct for both the inside and outside of the flange, but the opening is widened so that the two parts are separated by about 3/8 in. After finishing one side of the flange it is only necessary to move the head over 3/8 in. to finish the other.

Strength of Cast Iron.—It was pointed out before the Society of Chemical Industry that the strength of cast iron was affected by the addition of wrought iron in the following proportions: With 100 parts of cast iron 10 parts of wrought iron increases the strength 2 per cent; 20 parts of wrought iron increases the strength 32 per cent; 30 parts of wrought iron increases the strength 60 per cent; 40 parts of wrought iron increases the strength but 33 per cent. The maximum result is therefore produced with 30 per cent wrought scrap.—*American Machinist.*

Substitute for Wooden Patterns.—Some of the objections to wooden patterns, on account of the grain of the wood and the pronounced effects of temperatures, are claimed to be overcome by a composition of three parts starch, one part ground glue and two parts fine resinous sawdust, mixed into a paste by the addition of water. The sawdust should not be added until the starch and glue have been dissolved by the water. After the ingredients are thoroughly mixed, the whole is heated to 190 deg. F. and continued until it becomes a hard mass. It is then allowed to cool, when it is ready for removal from the receptacle. The resulting composition is a strong, hard, horn-like substance that can be machined, sandpapered and varnished the same as wood. It is decidedly less inflammable than the latter.—*American Machinist.*

# MASTER BOILER MAKERS' CONVENTION

## Oxy-Acetylene and Electric Welding Processes in Boiler Maintenance; Treatment of Feed Water

The ninth annual meeting of the Master Boiler Makers' Association was held at the Hotel Sherman, Chicago, May 25-28, President James T. Johnston, Atchison, Topeka & Sante Fe, presiding.

An address was made by E. W. Pratt, assistant superintendent motive power and machinery, Chicago & North Western, of which the following is a brief abstract: The work of boiler inspection has been carried on and developed by the government with very little opposition. The government inspectors and the railroad representatives have co-operated for the benefit of both and of the public. There were good reasons for some of the railroad legislation enacted during the past years, but the general opinion seems to be that this has been overdone and that the railroads have been exhausted by the excessive doses of correctives applied. They now need a rest.

Statements made before legislative committees as to the millions of dollars involved by certain enactments do not produce any very great effect. On the other hand, a simple statement made before such a committee in reply to a request for detailed information from the general manager on any topic and showing, for instance, that it is necessary for a railroad to haul 4½ tons of coal one mile to pay for the cost of a postage stamp, has a much better effect on the committee and the galleries than many statements in which millions of dollars figure.

Mr. Pratt also mentioned the tendency of politics to become cleaner and the necessity of men in responsible positions, such as occupied by the master boiler makers, taking an active part in civic affairs. Decreasing the revenue of the railroads, coupled with increases in taxes and wages, makes it dependent upon all interested to see that conditions are improved. To this end every man should go to the primaries and see that the proper men are nominated and elected. Keep in close touch with the employees. Be fair and honest with them, for without the support of rank and file no man can secure permanent advancement. Be courteous and considerate, and be as careful as to how a thing is said as to what is said, and the strength of the individual as well as the Master Boiler Makers' Association will be augmented.

Mr. Pratt recommended the use of oxy-acetylene and electric welding machines and urged the necessity of having as many shops and terminals as possible equipped with them. He also directed attention to the necessity of following closely the minute details of boiler work, such as keeping the flues clean; inspecting the beads on flues; boring out flues; inspecting beading tools to see that they are in proper condition; maintenance of arches, ash pans and front ends; watching the tendency of the sheets to corrode at the grate frame and packing the space between it and the sheets with something to keep the ashes out; last of all the advisability and necessity of being courteous to the men.

The treasurer's report showed a balance on hand of $758.66. The secretary's report was not ready because of illness.

Frank McManamy, chief boiler inspector of the Interstate Commerce Commission, presented a paper in which he called attention to a tabulated statement of the work that had been done in the matter of boiler inspection by the commission during the first nine months of each of the fiscal years, 1912 to 1915 inclusive, with the results that had been obtained therefrom.

While the decrease in the number of accidents, as a whole, and in the number of casualties resulting therefrom, has been remarkable, there are certain types of accidents which show either no improvement or a very unsatisfactory one, thereby indicating that the causes of such accidents are not being given sufficient consideration.

The credit for the results obtained as shown in the percentages does not all belong to, nor is it claimed by the representatives of the government, as it is fully realized that, without the co-operation of those in charge of the maintenance of locomotive boilers, it could not all have been accomplished. The statement has been made in a few instances that the Federal boiler inspectors are not co-operating with the railroads because they refuse to permit defective equipment to remain in service. The purpose, for which co-operation is desirable, is to improve conditions, thereby reducing the number of accidents and it would not be permitted under the law to co-operate for any other. Therefore, to co-operate with this end in view means to be diligent in the effort to discover defects and to require repairs to be promptly made, and it should mean the same thing to the railroads.

One of the causes of accidents, in the prevention of which satisfactory progress is not being made, is arch tube failures. Of course, when we take into consideration the increased number of arch tubes in use, some progress towards preventing failures has been made, but inasmuch as the records show that approximately three out of every four of such failures are due to improper application or failure to keep the tubes clean, the progress made is far from satisfactory and the remedy is, to a great extent, in the hands of the master boiler makers.

Accidents due to flue failures also indicate that, in too many instances, quantity rather than quality is the controlling factor when passing upon the qualifications of the flue welder.

Failure of injector steam pipes is another source of accident in the elimination of which satisfactory progress is not being made.

Without any intention of opening or influencing the discussion of a subject which has not yet been presented to the convention, its importance, due to the disposition to extend its use and the prominent place it is given in the program, will justify making clear at this time the position which has been taken in regard to it. It is the matter of autogenous welding, upon which two committee reports are to follow. While the art of autogenous welding as at present practiced is comparatively new, the number of uses to which it has been successfully adapted indicate its value; therefore, the commission has hesitated to attempt in any way to restrict its use, preferring to allow its usefulness to be developed to the fullest extent consistent with proper condition of equipment. Like many other valuable ideas, some of its overenthusiastic friends are using it to an extent and for purposes which are resulting and will result in retarding its development and restricting its legitimate field, as it is not a cure all for all boiler ills.

Welding over staybolt heads so they could not be tested, and renewing, in the same way, button heads, which on account of leakage had been heavily calked and could not be kept tight, are practices to which objection has been made. It is also held that autogenous welding should not be used to repair any part of a boiler that is wholly in tension under working conditions. To its proper use on stayed surfaces no objection has been made, for the reason previously stated. There is no desire to hamper, in any way, the proper development of any useful art.

### OXY-ACETYLENE PROCESS FOR BOILER WORK

The report, after citing the necessity of having an oxy-acetylene apparatus in the boiler shop, gave a partial list of the work that can be done with it. This list, with the methods used, is as follows:

Welding in side sheets and patches. When welding in side sheets, some boiler foremen make an allowance for contraction

by dropping one end of the sheet, while others get good results by not making any allowance for contraction. The welding in of side sheets, instead of riveting them, has been made a standard practice by some railroads; in fact one railroad is now cutting the side sheets off just above the mud ring and also at the seam at the crown sheet. In this way they save taking out the mud ring rivets and do not disturb the corners. When welding patches in side sheets, good results have been obtained by putting in round or oval shaped patches. Other roads use disk or make box patches for welding. It is necessary to do this to take care of the contraction.

Building up washout plug holes around the firebox or front flue sheet.

Welding cracks in side sheet doors and crown sheets.

Welding up cracked bridges in flue sheets. One method used in welding cracked bridges is to cut out the crack, then hammer the ends of the bridge in and weld. After it is welded and while hot, it should be hammered back straight. This takes care of the contraction. There are some welders who can weld broken bridges without doing this.

Welding seams in door holes instead of riveting or plugging. This is done in two ways; one is to make the lap of the door flange long enough to cover the holes in the back head and weld what would be the calking edge, if rivets were used. The other is to cut the flange in the back head off just back of the rivet holes and butt the door flange to it; then weld it the same as welding in a patch or side sheet.

Welding in tube sheets and door sheets. This is now being done by some railroads; in fact, fireboxes are now being applied and the only rivets used in them are those in the mud ring.

Welding cracked and broken mud rings. The general practice in welding cracked or broken mud rings is to cut a piece out of the firebox sheet, then cut a V-shaped piece out of the mud ring and weld the ring from the top side, although some successful welds have been made by cutting out a V-shape and making the weld from the bottom.

Welding tubes in back tube sheet. The welding of tubes in back tube sheets does not seem to be as successful with oxy-acetylene as with the electric process. It is also slower. Some success has been reported where copper ferrules are not used.

Welding up pits in tubes. Large savings are reported by some railroads doing this.

Welding safe ends on superheater flues. In doing this, two methods might be mentioned; one is to butt weld by placing the flue and safe end in an angle iron, spot weld it in four places, then turn the flue while the operator welds it. The other way is to bell the flue if the weld is made on the firebox end and insert the safe end, leaving a lap of ½ in. The weld is then made at the edge of the flue. If the weld is made on the front end of the flue, the safe end should be belled. This is done so the edge will not obstruct the flow of gases or the flames get under the lap. The claim made for welding flues in this manner is that in case the weld should fail, the danger of breaking off is removed by the lap holding the flue.

Welding up staybolt holes in side and crown sheets. This saves bushing holes and sometimes patching.

Some of the uses for the cutting torch are: Cutting out shell sheets; cutting out firebox sheets; scrapping boilers; cutting out superheater flues; cutting out countersunk rivets; cutting off rivets on shells and mud rings; cutting off staybolts and radial stays; and cutting off staybolt ends for driving.

In order to use the oxy-acetylene process to the best advantage, the shop should be equipped with an acetylene generating plant and piped throughout.

When portable outfits are used, time is lost and it is also necessary in most cases to send a helper with the operator to help with the tanks. When very many welders are used, one good operator should be advanced to chief welder and his duties should be that of an instructor when breaking in new welders, and to see that torches, hose and gages are kept in shape at all times, and that work is properly prepared for welding, as many failures in welding can be traced to the work not being properly prepared. An accurate check should be kept to show the cost of every job of welding that is done, as there is danger of doing work with the oxy-acetylene torch that could be done cheaper some other way. Men should be picked for welders with care and instructed for a time by a competent welder.

Without going into the chemistry of the subject, it is pertinent to point out that purity in oxygen is of first importance, not only because the foreign matter usually enters to some extent into combination with the metal of the weld, but because the flame temperature is reduced and the rate of welding or cutting is also reduced. Oxygen loses rapidly in efficiency with each per cent of impurity much the same as incandescent lamps lose rapidly in candle power for small drops in voltage.

With reference to the manufacture of oxygen, it was stated that at the present stage of the art, it is unwise for any company to generate oxygen by chemical means unless in some small shop exceedingly remote from any source of supply of commercial oxygen. Because of the occasional polarization difficulties, the manufacture of electrolytic oxygen must be attended by frequent purity tests since the percentage of hydrogen is increased on the oxygen side of the polarized cell. Three per cent of hydrogen renders oxygen unsafe.

The largest producer of oxygen in this country employs the liquid air process. That company is admirably equipped for meeting its customers' needs, since it has 10 plants and 16 warehouses at important cities throughout the country. Any user realizes the value of an unfailing oxygen service represented by numerous charging stations and by hundreds of thousands of cylinders. Since freight charges enter into the cost of oxygen, numerous sources of supply and cylinders of minimum weight are both important factors.

Liquid air oxygen has a very small percentage of nitrogen which, being an inert gas, does not make an explosive mixture with the oxygen, and on that account the liquid air product is absolutely safe. Recent competitive tests in cutting operations have shown liquid air oxygen to be high in efficiency; in fact it invariably demonstrated its superiority over oxygen produced by other systems.

Oxygen cylinders can be brought to the work, but in large shops, or in fact in any shop employing two or more welders it is better to install a pipe line and to discharge a battery of 10 to 20 cylinders into it through one reducing valve. This plan has the advantages, first that the gas is available at numerous points in the shop, and second that the operators lose no time through shortage of oxygen, or through carting cylinders from job to job or to and from the storehouse. A continuous supply of oxygen is a valuable asset in doing long jobs.

Acetylene can be used with perfect safety. In selecting a generator, one should only consider those which have been approved by the laboratory of the National Board of Fire Underwriters. None but carbide to water feed should be considered.

In this country there are two principal classes of generators; high pressure, by which is meant pressure over one pound per square inch, and low pressure, or less than one pound per square inch. All things considered, the low pressure type is the better for railroad work. Some reasons are outlined below:

Low and constant pressure is desirable for safe and economical operation. The Underwriters' rules prohibit pressures, on undisolved acetylene, in excess of 15 lb. per sq. in. Most high pressure generators work up to 15 lb., which is taken as the maximum safe pressure because acetylene is unstable under high pressures and one of the essentials, in fact the greatest essential of safe operation is low pressure.

It is absolutely certain that any shop possessing apparatus generating or storing free acetylene above 15 lb. pressure is courting accident.

In order to obtain high efficiency from blow pipes, steady acetylene pressures are imperative. When a blow pipe has been

adjusted for a given pressure of acetylene, if the pressure changes, then the proportion of oxygen to acetylene is varied and imperfect combustion results; or, in other words, the flame does not remain neutral. A decrease in acetylene pressure gives an excess of oxygen, resulting in a tendency to burn the metal. An increase in acetylene pressure tends to give a reducing flame favoring absorption of carbon by the metal and also, in some cases, causing the weld to become porous.

This is a matter of great importance and wherever blow pipe operators have contended with constantly varying pressures, especially in boiler work where strength of welds is paramount, neither the men nor the process should be censured if failures resulted. If good results were obtained the operators must have been very competent and highly conscientious in their efforts to maintain proper proportions of oxygen and acetylene.

This important feature is mentioned here, in connection with high and low pressure generation, since the former usually depends on a change in the pressure of the gas to actuate the carbide feeding mechanism. Low pressure apparatus, on the other hand, depends for feeding carbide on a variation in the volume of the gas in the holder and in no way on a pressure change. The advantages to be derived from constant pressure cannot be over-emphasized.

A pair of low pressure generators, with a common gasometer discharging to a pipe line is admirably fitted to give a continuous supply of gas so that operations are not interrupted by recharging. High pressure generators do not operate well in duplex arrangement, and when used singly are the cause of much delay and loss in efficiency due to necessity for reheating welds, which have been allowed to cool at the time of re-charging.

It is not wise from the standpoint of safety to truck any form of acetylene generator through a crowded railroad shop. Danger from tipping over, collisions, falling objects, electric wires, portable furnaces, etc., make it much more risky to use a portable generator than to isolate a stationary machine in a small separate building designed for the purpose, and to carry the gas, by approved methods of piping, throughout the shops.

A question might well be asked concerning the attendance expense of the duplex generator. It is very low. In one shop, near Chicago, employing nine welders regularly, one of them tends to the oxygen manifold and acetylene generator. Those duties occupy him, on the average, 1½ hours per working day of nine hours. Therefore the attendance requires 15 per cent of the time of one man out of nine or 1.85 per cent of the total time of all the welders, which is an almost negligible item of expense.

No operating problems are involved, providing the pipe lines are properly laid out and installed, to give safe and economical service, such as hydraulic flash back traps which absolutely prevent fire from traveling backwards through the hose to the pipe line.

Without going into details here, it is correct to state that any shop, regularly employing two or more welders should pipe for both oxygen and low pressure acetylene, rather than to use any form of portable apparatus.

Because of the unstable nature of acetylene under pressure, it cannot be stored in tanks or cylinders like air or oxygen, but must be compressed in receptacles containing fibrous material, usually asbestos and also a liquid known as "acetone."

Acetylene in this form is very useful for lighting purposes and for operating blow pipes at remote points, where pipe lines do not reach and generators would prove too bulky. Emergency work, such as cutting operations at wrecks or occasional jobs at small outlying shops, can best be handled in this way, but it is not advisable for many reasons to regularly use the tanks in shops employing two or more operators.

The main repair shops of railroads owning 150 or more locomotives, should not entertain compressed acetylene installations, simply because the volume of work warrants a generator plant in order that the highest operating efficiency may prevail.

Compressed acetylene costs the consumer from 2½ cents to 3 cents per cubic foot at the blow pipe, when all items of expense are considered, such as first cost, freight, investment, etc., compared to a cost of less than one cent for acetylene from a generator. The presence of the acetone in the cylinders, mentioned above, has an important bearing on operating expenses. Most acetylene cylinders are made in sizes suitable for lighting purposes, where the demand of the burner is much less in cubic feet of acetylene per hour than when blow pipes are used, especially the larger ones, such as used on locomotive work. Consequently when the blow pipe requires from 40 to 60 cubic feet of gas per hour, as on plates ⅜ in. thick and larger, on mud rings, frames, etc., the cylinder is worked beyond capacity, especially if not freshly charged, and there is difficulty in getting ample acetylene for the burner, without drawing out some of the acetone, which has the bad effect of reducing the temperature of the welding flame, thereby reducing the efficiency and raising the cost of doing work. Also the replacing of acetone at the time of recharging is a factor in the cost of gas.

In the use of the blow pipe, a wide range of welding tips should be provided, not less than ten different sizes, and so designed that an operator can quickly change from one to another. Four sizes of cutting nozzles, at least, should be provided, so that high efficiency may prevail in cutting all thicknesses of metal.

Cutting blow pipes should have an instantaneous lever control of the cutting supply of oxygen, and the preheating jets should be grouped around the cutting jet so that the blow pipe is "universal," that is to say, that no matter in what direction parallel to the surface being cut the blow-pipe tip is moved, a preheating flame will always lead the cutting jet. Unless the jets are so arranged, the operator must keep the axis of his blow pipe in line with the cut and that is extremely difficult on many jobs, such as, for example, in cutting firebox sheets near the corners.

Provision for controlling the size of preheating jets, regardless of the oxygen pressure and size of nozzle, is a recent development in the cutting blow pipes furnished by a large company, which permits the operator to adjust the intensity of his preheating jets to the needs of the work. Varying intensities of preheating flames may be desired even for a given thickness of metal, and for one size of nozzle and oxygen pressure. For example, intermittent cutting, as on staybolts with short cuts and much preheating relative to the length of cuts, requires stronger preheating jets than is needed for a continuous cut on a long sheet of the same thickness. Round surfaces do not preheat as quickly as thin sections or sharp corners.

It is of the utmost importance that a proper filler metal should be selected for welding. Norway iron wire of great purity is best for firebox work and no flux is needed, but it is not the best practice to weld a cast steel mud ring with that metal, which has 48,000 lb. tensile strength, when the mud ring steel probably has a strength of from 60,000 to 75,000 lb. per sq. in.

It is not sufficient to use a "filler" of the same grade as the metal to be welded, or to use one which might seem even better in quality than the object to be welded. For example, any cast iron to be found on a locomotive no matter how good it may be for the purpose it was made, does not make a good "filler" on a casting where it is important to get a clean, strong weld, which works well under a tool. The reason is, that on cast iron work a special alloy "filler" iron containing from three to four times as much silicon as is found in ordinary foundry castings is needed. The excess silicon replaces that of the welded casting, oxidized in the making of the weld, and since the silicon controls, to a large extent, the proportion of combined and free carbon which there is in the casting, it cannot be removed without hardness resulting.

Oxy-acetylene welding, to be carried on with best of success, must include the use of "fillers" and fluxes specially compounded to meet the needs of the different metals to be welded. This ap-

plies to all forms of iron and steel, forgings, plates, shapes and castings, and to copper, brass and aluminum.

DISCUSSION

Attention was, at first, called to the wide range of work that can be done with the oxy-acetylene apparatus in reclaiming old material, such as steel castings, forgings and in cutting up sheets and structural material, after which the discussion was confined almost solely to the consideration of its uses for welding.

Insistance was repeatedly placed on the necessity of having the work done by skilled men, and especially of having the metals hot enough to flow and come together; for, unless they are melted and if the welding material is allowed to flow in before the proper temperature is reached, there will be no weld.

Care must also be exercised to see that the proper proportions of oxygen and acetylene are used. If there is too much acetylene there will be a tendency to crystallize the metal, and if the oxygen is in excess the metals will be oxidized. It is also well to have the sheets brought together and heated to a welding temperature so that they are really joined before putting in the welding material. If this is done there is no reason why from 96 to 98 per cent of the welds should not be good.

As for the vertical cracks that occur it was generally agreed that it had best not be attempted to weld them if they were more than 6 in. or 8 in. long. That is to say this should be the practice in the back shop. Where the work is to be done in the roundhouse so as to keep an engine in service, then longer cracks can be handled, though the work should be considered to be of a temporary character. To this it was objected, that, if it was possible to weld in patches that measured 30 or more inches square, where there was a vertical weld between the old and the new plates, it seemed reasonable to think that a vertical crack of the same length could be welded. Several methods were proposed for avoiding long vertical seams in patches. These were the use of circular or oval patches and the placing of rectangular patches so that the sides should be inclined and thus so that there should be neither horizontal or vertical welds, but inclined ones. The difficulty with the making of vertical welds seemed to lie in taking up the contraction of the plate after the work had been done.

One speaker suggested a method which had been used successfully in caring for vertical cracks, and that was to drill out the crack for the whole length. The crack is drilled out with holes of about ¼ in. diameter and spaced as close together as they can be drilled, leaving barely an eighth or sixteenth inch of metal between the holes; then cutting a V in the bridges thus left and welding the whole tight by flowing metal into the spaces thus left open.

As for the location of the work it was considered to be a matter of no importance, except for convenience and rapidity of action, as to the position. Overhead work can be done as well as that which is down.

There was some discussion as to the best methods of holding and placing work to be welded. In this there were two distinct methods that were proposed. One, and that most commonly used, was to set in the piece to be welded and drop it on an incline from one end to the other at the rate of about ⅛ in. to the foot and then make the weld. The other was the fastening of the piece in the place that it was to occupy. In the first, the dropped end was gradually brought up into place with reference to the other sheet as the line of the welding approached, thus taking care of the contraction that follows the heating of the metal.

Where the metal is fastened it may be tacked in place either by welding in spots along the seam or it may be put permanently in place by putting in all of the staybolts or other connections that are to be used in the completed work. This last received some criticism, but it is being used very extensively on a large road.

With reference to the pressures to be used it was recommended that these should be about 9 oz. for the acetylene and about 50 lb. for the oxygen. Above all, constant attention should be employed to see that the cones are kept in proper shape.

Of some of the special pieces of work that were cited, that of putting in mud ring corners was one. In this the corner can be cut out and the new piece welded in and the whole of the work done in 11 or 12 hours. Working in the same place the sheet can be cut out around a washout plug and a new piece put in, leaving the condition as good as new and thus overcoming all of the trouble that follows from the corrosion of the sheets at these points. On one road 1,000 mud ring corners had been repaired in this way during the past four years.

Where long seams are to be welded, it is well not to stop the work after it has been commenced until it is finished. It was found that where failures of the welds occurred it was at points where the welding had been stopped at night or noon. It is well, therefore, to see that, when a weld is started, it is finished before the metal is allowed to get cold. To do this it is necessary to employ two welders who will relieve each other and keep the work going until it is finished. As for the rate of welding, it can be done on a half-inch sheet at the rate of about 2 ft. 4 in. per hour. Among the novelties of firebox work that were brought out was that of cutting out the old box without removing the back head and putting the new box in in two pieces and then welding these two pieces together when they were in place. It was stated that 120 staybolts had been cut off in 13 minutes, and from 5 to 8 radial bolts in a minute. In taking out a firebox, the work can be done in one day and the staybolts can be burned off at the rate of from 150 to 200 per hour; welding can be done at the rate of 18 in. per hour at a cost of $1.50. Some attempts had been made to weld tubes in place, but it was considered advisable to do this by electricity and to always use the copper ferrule.

It was acknowledged again and again throughout the discussion that much of the success of the work depended on the water that was used in the boiler after the work was done. It was recognized that bad water had a deleterious effect on a welded seam just as it has on one that is riveted, and that work that might be considered very good and satisfactory, where the water was good, would not give good results when worked in a bad water district.

Some prices were given for the work; welding can be done at the rate of 2 ft. 4 in. per hour and at a cost of $1.23. Cutting can be done at the rate of 2 ft. 3 in. per minute and at a cost of $2.94 per hour. Staybolts can be cut at a cost of 1.8 cents per bolt. A firebox can be cut out without taking out the back head at a saving of $58 over the method of cutting out the rivets. The cost of labor in one shop for the welders ranged from 20 cents per hour for the man who was new and was learning to 36 cents per hour for the skilled welder.

A model was shown in the form of a completely welded firebox similar to some that are in use on the Lehigh Valley. This box had no rivets in it. The inside sheet was welded at the front to the back tubesheet and at the rear to the back sheet of the firebox. The advantages claimed for this construction were that the box presented a perfectly smooth surface inside and out.

## ELECTRIC WELDING IN BOILER MAINTENANCE

It was the oipnion of the committee and a number of boiler makers who were consulted, that it is a mistake to weld cracks in fireboxes more than 8 in. long, as it is only a temporary job and gives much trouble; they have to be rewelded often and this should not be practiced in back shop repairs. A horizontal crack can be more successfully welded than a vertical crack, as the expansion of the firebox is more even vertically than horizontally. This is true in welding cracks in the top flange of tube sheets, as horizontal cracks have been welded and known to give good results for engine house repairs, holding up for six and eight months when cracks from tube holes to rivet holes have to be rewelded often.

In getting sheets, patches and cracks ready for welding, the best results are obtained by beveling both edges of the sheets, or cracks at 45 deg., and leaving an opening 3/16 in., so as to get the weld through the sheets. In building up thin spots or reducing the size of holes, all scale and grease should be removed, as clean sheets insure good welding. All welds should be built up 1/16 to ⅛ of an inch.

The chairman of this committee has had unlimited success in welding tubes at the firebox end and at the time of this report, the Erie division of the Northern Central has tubes welded in passenger service that have been running two years and three months.

The welding of tubes, if properly done, will reduce the tube troubles to a minimum. Where tube welding is a failure it is usually due to the use of improper methods.

The tubes should be applied the same as if no welding was being done, except that no oil should be used on the tools in working the tubes, for electric welding is unsuccessful if oil is on the work. The proper way to prepare tubes for welding is as follows: After ferrules are applied and tubes in place, an oil soft soap should be used as a lubricant instead of oil, on the tube prossers and rollers, after the tubes are beaded; rough the sheet around the head with a roughing tool ¼ in. wide. This will remove all the scale from the sheet and gives good metal for welding; then heat the sheet with a burner, which will burn up the soft soap, and this will leave the sheet free from grease and the tubes are ready for welding. Any time the sheet gets wet, dry it or leaky tubes will result.

Care should be taken that the voltage is not too high. High voltage makes it easier for the operator, but it is not good for the tubes, as the operator with high voltage keeps the metallic pencil ½ to ⅝ in. from the sheet and the metal only sticks and does not weld. A voltage of 64 volts, and 125 amperes makes the operator get within 3/16 in. of the sheet and at this distance a good weld results.

As good results are not obtainable in welding tubes that have been in service eight to ten months before welding, as from welding tubes at the time they are applied. Tubes, if properly welded at the time they are applied, should give three years' service as far as the firebox end is concerned. It pays to weld tubes if only one year of service is obtained as it will eliminate the engine house tube trouble.

The general opinion of the committee is that it is an advantage to use electric welding for side sheets, patches on mud ring corners, small cracks, building up thin spots on sheets and welding tubes, but a disadvantage to weld long, vertical cracks in any sheet where there is expansion and contraction.

#### DISCUSSION

The discussion was almost entirely limited to a consideration of the welding of tubes, as this was the principal use to which the electric welding was applied. The method first recommended for this was that no oil should be used on the work. The holes should be drilled with soda and a soft soap made of linseed should be used with the expanding and rolling tools.

It was quite agreed throughout that it was not possible to secure as satisfactory a piece of work in the welding in of old tubes that had been rolled and expanded, as it was with new tubes, and that when such tubes were offered it would be better to take them out and weld on safe ends than to attempt to do a permanent job on the old tubes.

It was also agreed that the use of the copper ferrule was necessary, though some objection was raised to this on the ground, not that it had been found to be possible to do without it but that it ought to be possible to do so in order to cut down the expense. If all of the regular work is to be done, what is to be gained by the welding of the tubes. To this it was replied that the work was far more durable and that the greater lasting powers would more than make up for the extra cost.

In welding cracks with the electric process it was recommended, instead of making a complete weld for the whole length of the crack that the wire be laid in the bottom of the V for a short distance at a time, thus fastening the two sheets together and, then, that the metal should be built up to the full thickness of the sheet. This was not considered essential to success, but it was recommended as being a method that would be apt to give satisfactory results.

One of its advantages is that there will be less trouble with the expansion and contraction of the metal, in that after the first layer has been put in place there is a chance for the metal to cool before the V is built up to the full thickness of the sheet.

As in the case of the oxy-acetylene method the electric welder is used for a great variety of work, though it was not considered to be as economical as the former for the welding of side sheets.

In this, too, a great deal depends on the quality of the wire that is used. A soft pliant wire, for example, does not seem to have enough vitality and is apt to drop off. The best wire is that made from good Swedish iron. Too much emphasis cannot be placed on this, as cracking welds are very apt to result from the use of bad wire. The wire should show a good elongation in the testing machine.

The voltage ordinarily used was from 58 to 64, though it was recommended that as low as 35 should be used with a corresponding increase of the ampereage.

The electric method is used for the welding of the bridges in tube sheets. It was recommended that, for this work, the V's be cut in from both sides and the weld built up accordingly because, by putting the metal in on each side of the sheet, there would be avoided any tendency to warp.

The arc should also be so regulated that the pencil may be held at about 3/16 in. from the work; if the current is so strong that it can be held farther there will be danger of burning the metal.

Some trouble has been experienced from the cracking of the new sheets of patches near the line of the weld, but not in the weld itself. It was thought that this was probably due to the treatment that the sheet had received or to some defect in the metal itself. For in many cases electric welds have been made that were stronger than the metals welded and when the work was put in the testing machine and broken the failure occurred outside of the weld and in the new metal.

It was largely a matter of what sort of welding apparatus was installed in a shop as to how the work was done. Where there was nothing but an oxy-acetylene plant, then the work was done with that, and where there was nothing but an electric welder all of the work was done with that, except it was generally agreed that the welding in of tubes could be done much better with the electric welder than with oxy-acetylene. Where both plants were available there was a selective process going on and the work best suited to each was done by the respective methods.

### BEST STEEL FOR FIREBOXES

The committee in its report declined to make a recommendation and there was no discussion.

### UNIFORM RULE FOR LOAD ON STAYBOLTS

The maximum allowed load on staybolts and boiler braces has been fixed by the rules of the Interstate Commerce Commission, hence the committee confined itself to a recommendation as to the diameter of staybolts to be used. This recommendation was made because small staybolts are more flexible and give greater life to fireboxes than large bolts, the first firebox will last longer than the second; the second will last longer than the third. The less life of the second and third firebox is due to the increase in the size of staybolts made necessary by repeated application of staybolts. It was recommended that ⅞ in. staybolts be applied as a minimum and that 1 in. be the maximum size, and that all bodies of rigid bolts beyond 1 in. be turned down to 25/32 in. between the sheets.

## STANDARD SLOPE OF CROWNSHEETS

The investigations of the committee showed that there was no standard slope for crownsheets, but the recommendation was made that ½ in. to the foot be used, starting at the tube sheet and going back to the door sheet. The camber should be ¾ in. to the foot each way from the center.

Sheets constructed in this manner are comparatively easy to keep clean and free from scale and sediment, and will give the best results.

The advantages of a sloping crownsheet are:

First: In case of low water the highest point in the crownsheet will become over-heated first, and in all probability will let go quicker and do less damage than if it had no slope.

Second: With this slope the heat strikes the crownsheet more uniformly and is more evenly distributed, thereby causing less strain on the sheet and giving greater life to crownsheets and better results therefrom.

Third: There is more absorption of heat units in the front end than in the rear end of the firebox, and more room is allowed for combustion to take place.

Fourth: A greater amount of heating surface can be used at the front than at the rear end.

Fifth: It gives more room for tube spacing in the back tubesheet.

Sixth: It also gives more room for cab and cab mountings.

The only disadvantage of the sloping crown sheet is that in the construction of the crown and side sheets in one piece there is more waste of material.

### DISCUSSION

It was brought out in the discussion that it was not necessary that there should be a standard slope applicable to all roads and conditions of service. Each road should be a law unto itself and the slope of the firebox should be made to conform to the maximum grade of that road. The slope should be such that when the engine is on that grade the crownsheet will be brought to a level position.

## TREATING LOCOMOTIVE FEED-WATER

The report gave a general review of the situation as to feed-water treatment and called attention to the fact that an untreated water, although low in incrusting solids, may have a decided tendency to cause foaming, when used in connection with treated water; and at the same time cause incrustations of injectors, line checks, and boiler check valves.

While no recommendation to that effect was made, the tone of the report seemed to favor the treatment of water in the locomotive tanks rather than in roadside treating plants.

### DISCUSSION

The discussion partook very much of the nature of an experience meeting. It was stated at the outset, that the treatment of water had effected a very considerable saving on the Missouri-Pacific. At Kansas City, where the water is of 36 grains of hardness, the life of tubes when using the raw water was limited to about 10 months, whereas by the use of water treated in a plant, the life had been lengthened to 21 months, while leaks in the firebox and cracks in the sheets had become things of the past. On the Colorado division pitting occurred to such an extent in the tubes that, after cleaning from scale, it was usually necessary to throw at least 65 per cent of the tubes into the scrap. The water also attacked the crownsheet. It has been found that it is not good policy to mix treated and untreated water in the boiler as it is apt to start pitting and other troubles. On the Wichita division, there are no treating plants and the water is treated with soda ash in the tanks, and here, too, the life of the tubes has been increased from 9 to 14 months. However, it is generally recognized that it is not desirable to use the boiler as a treating plant and that the work had best be done before the water is put in the boiler.

This attack on tubes by the water of the Colorado division was not due to the kind of tube used, as experiments had been made with every tube on the market, the results all being the same. In these bad water districts it is necessary to wash the boiler out every 400 miles.

Another speaker stated that the use of soda ash had made it possible to extend the period between washouts by 33 per cent and that there had been no bad effects noticed as the result of the soda ash treatment.

One representative had had an extended experience with the use of polarized mercury and he found that the period between washouts could be extended by about one-third. He had found that there is considerable difference in the manner of the circulation of the water when used in boilers having long tubes from what it is in those with short tubes and that this circulation is much freer with the latter. Polarized mercury does not create any tendency to pit, nor does it produce any galvanic action, and when it is used the tubes have a life of about two years and seven months, possibly a little more. Put in figures of miles run this means that the tubes have a life of about 120,000 miles, whereas, before this, they were sometimes limited to 17,000. There were records of a tube life of 147,000 and even 262,000 miles.

In another case it was found that the failures of tubes as indicated by cracking had greatly decreased after the introduction of soda ash treatment, while the number of burst tubes had greatly increased, as the soda treatment seemed to have increased the tendency to pit.

There was a marked difference in the action or apparent action of locomotives fitted with superheaters from those using saturated steam. With the latter, when the tender treatment had charged the water up to the foaming point the foaming was very evident, but in the case of the superheater locomotives, considerable foaming could apparently occur and the water that was carried over into the superheater pipes would be dried out and be delivered to the cylinders in the form of steam.

There was some evidence given to support the idea that the use of soda ash tended to cause pitting, though there were a number of speakers who stated with great positiveness that they could not detect any such tendency.

It was also agreed among those who had had any experience in the use of pure water, such as water that had been treated to a condition of purity, or rain water, that such waters did have a tendency to produce pitting.

## CROSS STAYS IN FIREBOXES

In the Belpaire firebox, and some designs of crown bar fireboxes that have flat or nearly flat surfaces where sheets converge from the side to the roof, it is necessary that they be properly braced with cross stays. In this construction, however, there is a considerable distance between the connections of the firebox staybolts to the roof sheet and the necessary slings, braces or stays in the crownsheet, which permits of a certain flexibility that will allow some adjustment to take care of the stresses which are the result of the greater expansion of the side sheets of the firebox under the high temperature of direct contact with the fire, as compared with the expansion of the outside side sheets.

The radial stay boiler, however, should have a circular cross section above the crownsheet, and the use of cross stays in this type of boiler restricts the proper equalization of stresses, which result from the unequal expansion of the firebox, as compared with the roof sheet, which, in the case of radial stay boilers, has practically a continuous connection through the staybolts and radial stays. It is believed that a rigid cross stay above the crownsheet in a radial stay boiler increases the bending stress in radial bolts at about the line where cross stays are applied. Breakage of radial staybolts, in the zone indicated, has been experienced, due to the presence of cross stays in this type of boiler, and when their use was discontinued no further trouble from this cause was apparent. The committee does not consider

cross stays in the radial stay boiler desirable or necessary, provided the boiler is properly designed with a circular cross section.

In conclusion, it was stated that although the cross stays are necessary in the Belpaire and other fireboxes having flat surfaces, they necessitate the use of extreme care in washing the crownsheet, owing to the numerous interstices between the cross stays and crownbars or sling stays, in which mud and scale collects and becomes difficult to dislodge.

DISCUSSION

From the tone of the discussion it would appear that it was a matter of indifference as to whether cross stays were used on some classes of boilers or not. On the old crown bar boiler where the stays ran between the crown bars they were a necessity where there were any flat surfaces, but they have been removed, without trouble resulting, from boilers where the roof sheet is a true circle from the top rows of regular stays. In the case of the Belpaire boiler, where there are flat surfaces, it was agreed that the cross stays are required. It was assumed as a general opinion that it was a matter of local conditions, depending partly on the quality of water that was used, as to whether cross stays should be used or not, always excepting the presence of flat surfaces.

## REDUCTION OF STRENGTH IN CORRODED OR PITTED BOILER SHELLS

An examination, supplemented by drilling at what appears to be the thinnest part, should be used to determine the thickness of the sheets, and in no case should the boiler be allowed to pass without repairs if the percentage so found has approached closely to that of the joints carrying the same strain.

DISCUSSION

It was suggested, inasmuch as there is no law or generally accepted practice in this matter that the marine regulations should be adopted, in which the thinnest part of the sheet is the controlling factor. It was also suggested that the age of the boiler should be taken into account in determining the reduced percentage of strength that should be allowed and the practice of the Pennsylvania Railroad was cited as a case in point. On that road the factor of safety is made 4 for the first five years; from 5 to 10 years it is 4½; from 10 to 15 years it is 5; from 15 to 20 years it is 5¾; from 20 to 25 years it is 6½; from 25 to 30 years it is 10 and at the age of 30 years the boiler is scrapped.

## CONSTRUCTING LOCOMOTIVE TANKS

The report consisted of a brief review of the steps to be taken in the construction of a tank of the ordinary type with a mere reference to the circular tank of the Vanderbilt type.

DISCUSSION

The only thing of any moment that was brought out in the discussion was the description of the new type of tank construction used on the Lehigh Valley. Here, instead of using the usual angle for connection between the sides and bottom of the tank, the latter is flanged upward all the way around and the side sheets are rivetted to it. This does away with the rivets in the bottom and there are none below the ones that hold the sides in place. This does away with the trouble with leaks in the bottom seams and the necessity of lifting the tank from its framing in order to make repairs at that point. Rivets ⅝ in. in diameter are used, spaced at the regulation pitch, and the joint is made up with a tar paper packing in the usual way. There is no calking and the steel used is tank steel.

## DRIVING STAYBOLTS

The objection to driving staybolts with pneumatic hammers and holding them on with a hand holding-on bar is that the vibration of the holding-on bar, when a pneumatic hammer is used, is such that a number of blows are struck by the hammer while the holding-on bar is rebounding; therefore the bolts are not properly upset in the holes, and naturally the method does not make a good tight job.

To drive staybolts or radial stays successfully with air tools, it is absolutely necessary to hold them on by the same process; the trouble is not in the driving of the bolt any more than it is in the improper methods of holding-on.

In driving these bolts, use a set slightly higher in the center than on the edge, with a small radius on the outer edge, and a staybolt set made especially for this work. This set is used on the inside, as well as the outside end of the bolts; this cuts off all the ragged particles that may be around the edge of the bolts, making a smooth job, which is less liable to gather any accumulations of foreign matter. This work is done with a No. 90 air hammer, and held on with air holding-on tools, made especially for this class of work. In some places a set is used with a center tit to drive the bolt on the outside. This is done where the tell-tale holes are put in staybolts before the bolts are applied. The tit is inserted in the tell-tale hole so as to keep the set centered on the bolt as well as to keep the tell-tale holes in the bolts from being closed up; this is also a very successful method, but some prefer to apply the bolts and have them driven solidly in the center, before the tell-tale hole is drilled. Either one of these methods is good practice.

The trouble with leaky staybolts is not always due to the improper driving, or methods used in driving. There are quite a number of other reasons that contribute directly to these troubles, and if not properly taken care of, the bolts will leak and give trouble, no matter by what method they are driven or held on. It is absolutely necessary to have good threads in all staybolts, as well as radial stayholes, and a full thread on all bolts. It is necessary to have bolts fit the hole properly. If the staybolt and radial stayholes are properly tapped, and the bolts have first-class threads, and are properly fitted to the holes, three full threads will be sufficient to make a good serviceable head.

The report closed with a recommendation to use a longstroke air hammer for the work.

DISCUSSION

The emphasis placed on the driving of staybolts by nearly every speaker was to the effect that the driving should be so done that the metal is spread in the thread so that this is made tight, and the driving down of the edges to form the head was a matter of secondary moment. The discussion started with the question as to whether the bolt should be cut off square or left with a slight bevel, on the ground that, with the latter, the driver would be more apt to strike the bolt in the center and thus upset it than if it were to be cut off perfectly square, when there would be the temptation, especially on piece-work, to simply hammer down the edges. This will make a joint that will pass inspection and stand the water test, but as soon as the engine is out on the road the bolts will loosen and there will be a leak unless it is well driven out in the threads.

It was apparent that it depended more on the way in which the work was done, that is its thoroughness, than on the particular method pursued. One speaker had had experience with all methods, from the hand hammer to the air hammer and the "double gunning," as it is called, where the two ends are driven at the same time with an air hammer at each end. In every case he had found that satisfactory work could be done. But it was urged that in the case of double gunning the men should be familiar with each other's methods and should work in unison, otherwise there might be faulty work done.

The use of oxy-acetylene for cutting off the bolts seemed to give the best satisfaction. It puts no strain on the bolt, the heat does not penetrate the sheet so as to cause any trouble in that way and it is exceedingly rapid, as many as 350 bolts being cut in 45 minutes. The length of the head that is to be left on was recommended to be from 2½ to 3 threads in length.

The cutting of good threads was especially insisted upon. If the thread does not fit it will be impossible to get a tight bolt

and the work of cutting these threads should not be given to an apprentice but be done by some one who knows what is needed and will see that the work is properly done. The cost of cutting off a set of bolts with gas was placed at $14, as against about $13 with the hammer, and the latter would be sure to loosen many if not all of them.

## REMOVING AND REPLACING FIREBOXES

On the different classes of boilers on the Santa Fe, there is an extra back end suitable for interchange so that when an engine enters the shop, the back end can be cut off and the extra back end complete with new firebox applied, holding the engine not to exceed ten days. This method has a new back end in reserve for interchange, and has proved a paying proposition.

It is not necessary to remove the frames or break the connection at the smoke box on engines of the modern type whose firebox is directly over the frames. Experience has also taught that it is a more expensive method to cut the back end and door sheet loose, in order to avoid cutting away at the connection.

In some cases where the O G box passes through the frames, it is customary practice to separate the boiler at the smoke arch and have the work done in the boiler shop, going over the machinery while the boiler is receiving a new firebox. Otherwise it is simply cut off and modern back ends replaced in the manner described.

It costs at the Topeka shops from $650 to $900 to put the firebox and back end in first-class shape, depending solely on the size of the boiler. Where the fireboxes are interchangeable, it is not necessary to bring the boiler to the boiler shop, but simply put it in the rear of the file of engines to be turned out of the shop during the month.

The way in which the work is done must be governed largely by the facilities of the shop doing it.

Where there are proper lifting appliances and the erecting shop space, it is more economical to lift the boiler from the frame and send it to the boiler department and the frame to a department for necessary repairs. This will give a track in the erecting department to repair another engine while the boiler and frame are undergoing repairs.

This was accompanied by a comparative statement of the cost of removing the boiler and of simply raking out the back head, which was as follows:

| | |
|---|---|
| Total cost of removing back head | $29.35 |
| Total cost of removing boiler | 22.31 |
| Amount saved by removing boiler instead of back head | $7.04 |

This is calculating the cost of putting in the firebox the same in both cases, but it would be slightly higher with the boiler on the frames.

The following statement was also given as to the exact cost of renewing a firebox in the boiler of a Consolidation type locomotive, having 413 2-in tubes, 1,065 staybolts, 315 crownbar bolts, with Tee bars and mud-ring 66 in. by 108 in. inside:

To remove and replace firebox by cutting butt at connection, $700; by cutting boiler off at smoke arch and removing from frames, $650; by taking out the back head, $775.

One contributor to the report suggested that, when the shop is cramped for room, boilers can be cut off at the connection, as the cost of removing the steam pipes to do this about equals the cost of the boiler job. He advocated removing the back head for the renewal of the firebox only when there were no crane facilities for handling the boiler and butt end.

### DISCUSSION

The discussion centered around the variations in the methods of removing and replacing the firebox without cutting out the back head, and this was the method in general that was used by the speakers with one or two exceptions. In detail, the work was done by cutting off all the staybolts and cutting up the inside sheets with a torch, merely leaving two staybolts in each piece that were cut off, to hold it in place until all of the work was done, and then cutting the pieces loose and allowing them to fall out. The work can be done with the boiler either in the frames or removed. Sometimes the firebox was burned out as a whole and dropped down; sometimes the boiler was turned upside down and the firebox lifted out. In some cases the firebox was put in intact and rivetted in place; in others it was put in piecemeal and sometimes each sheet was put in by itself and fitted and rivetted. In other words the new firebox was built in place. It seemed to make no difference whether the firebox were of the wide or narrow type, it is well to cut it out without removing the back head.

Some of the speakers make a practice of cutting away the connection between the boiler shell and the firebox and taking the back end to the boiler shop for repairs and either putting in another back end while the one removed is being repaired, or repairing it and rivetting it back in place. This method was criticized on the ground that the rivet holes between the shell and the back end might not come fair in case the latter is changed. This would be apt to be the case, where engines were received on different orders; for while all the engines of one order of a given class would be apt to have the holes laid out so that they would be interchangeable, the same class of engines on another order from the same builder might have the holes so laid out that they would not match. For example, in one case the layer-out might put the outer rivet hole in the center and another put the inner holes in that place. This was accepted as a fair criticism and it was acknowledged that great care had to be exercised to see that holes were true before any attempt could be made to use interchangeable fireboxes.

The question was asked as to how a firebox with a combustion chamber should be treated whose crown sheet was continuous and ran out to form the roof of the combustion chamber. The reply was to the effect that, in most boilers of that class, the sheet of the combustion chamber was welded to the crownsheet and it was only necessary to cut it off at the weld and after it had been replaced make the weld again along the same lines and the boiler would be put back in its original condition again.

In the matter of time required under these methods for the replacement of the firebox, from 16 to 18 days was given. Cases were cited of the replacement of the firebox for a heavy Mikado in 18 days; of putting in one for a Mallet in 16 days; of doing the work on a passenger locomotive whose type was not specified in 10 days and of one case where, on a hurry job, an engine was received in the shop on Monday morning and on Saturday morning it was ready for firing up. These were all working days of 8 hours each.

In all of this it was recognized that the precise method in which a piece of work could be best done was a matter of local conditions and facilities.

In the matter of making partial repairs, this method was criticized on the ground that it was not profitable to put in a half side sheet on each side and possibly a part of a door sheet, or make a similar set of repairs on a firebox, when for a little greater expense a whole new firebox could be put in. It left a part of the structure nearly worn out with a lot of new material that could have been more economically used in the construction of a new box.

### OTHER BUSINESS

The secretary's report showed that at the beginning of the year there were 419 members in good standing, that there were 77 new members taken in during the year and that there were 125 of these who were dropped, resigned or had died, leaving a present membership of 371.

The following officers were elected for the ensuing year:

President, Andrew Green, general foreman boiler maker, Big Four, Indianapolis, Ind.; first vice-president, D. A. Lucas, general foreman boiler maker, Burlington, Havelock, Neb., second vice-president, John B. Tate, foreman boiler maker, Pennsylvania Railroad, Altoona, Pa.; third vice-president, Charles P. Patrick, Erie Railroad, Cleveland, Ohio; fourth vice-president, Thomas Lewis, general foreman, Lehigh Valley, Sayre, Pa.; fifth vice-

president, Thomas F. Madden, general boiler inspector, Missouri-Pacific, St. Louis, Mo.; secretary, Harry D. Vought, 95 Liberty street, New York City; and treasurer, Frank Gray, 705 W. Mulberry street, Blomington, Ill.

## RECLAMATION OF MATERIAL

A report of the proceedings of the Railway Storekeepers' Association convention will be found in another part of this issue. The following is an abstract of the report of the Committee on Reclamation of Material:

The committee finds that a great deal has been accomplished in the reclaiming of material and also that there is much more to do than has been done. The work needs much systematizing, intelligent supervision, more efficient methods and machinery, and more education of the users of material as well as the reclaimers. There is a vast amount of money tied up in material in store stock under the supervision of the storekeepers, as well as money spent for purchases, which we are responsible for. How much can we reduce purchases and the amount of money tied up in stock material by more efficient reclamation, is the problem which we, as storekeepers, must solve.

The committee believes both purchases and stocks can be reduced materially by reclamation work. The reclamation of material should be under the supervision of the store department for the following reasons:

(1) The store department supervisors are already trained for the work.

(2) The assembling of reclaimed material, its classification, disbursement and accounting is directly in line with good storekeeping.

(3) Centralization of all discarded, second hand, obsolete and scrap material at designated scrap yards under the store department has been found by actual experience to be the best method. The handling of reclaimed material is store department work, as it already has the organization to reclaim that which is fit to use for the purpose originally intended and can easily supervise the work necessary to make reclaimed material into any shape desired. The store department knows what material cannot be reclaimed for any use and will quickly turn this into money to the best advantage.

(4) The store department has adequate records, showing amount of material used, knows how much of each kind to reclaim and will prevent big losses resulting from reclaiming more material than is needed. The store department will also prevent working over material that is not needed.

(5) The store department is in constant touch with the markets and knows at all times the different costs of all articles.

(6) The store department is not only interested in the use of material, but is interested in its abuse. Reclaiming material often shows where there has been abuse, and the store department is in the best position to stop abuse, as it is vitally interested, being measured by the purchases which the abuse increases.

(7) The store department labor force and handy men can do the work cheaper than any other department, as it is necessary for the other departments to do reclamation work in connection with their regular work, which requires high paid mechanics and skilled labor.

There can be no set rules or regulations to cover reclamation work, as the conditions vary so much that each individual case will have to be decided upon its merits. The committee finds, after careful investigation, that the railroads should build and equip efficient reclamation plants (these to be worked up gradually as the needs demand) to handle a large part of the reclamation work, if the best results are to be obtained.

The geographical location of the road, location of shops, scrap market, traffic tide, etc., should govern the location of a reclamation plant and scrap dock. It should be such as to save back haul of scrap, and at the same time give a minimum haul for reclaimed material and be a good distributing point. Of course, the present location of the scrap dock, size of shops using reclaimed material, land, tracks and buildings obtainable for reclamation work will have to be large governing factors in the location, as well as the size of the appropriation obtainable for this work.

Care must be exercised to see that the plant is so located that there will be room for future growth.

The size of the plant, of course, will govern the organization. The committee recommends that the reclamation plant and scrap dock be under one general foreman, whose rate of pay should be from $100 to $150 per month, to whom should report the foreman of rolling mills; foreman of scrap dock (rate of pay $70 to $90 per month); leaders (about one for every six laborers), 17 cents to 35 cents per hour; clerks; piece work inspectors; handy men for operating machines and doing special work (16 cents to 30 cents per hour), and laborers (at labor rates).

The leaders or gang foremen should be carefully selected and trained in their duties. By having leaders it only makes it necessary for the foreman to educate them and hold them responsible for work under their supervision, and then they in turn can educate the men.

The number of clerks and the rate of pay will depend on the size of the plant and work necessary to be done.

Handy men or operators should be used in reclamation plants instead of mechanics and journeymen. Much of the work of the reclamation plant is a growth of that formerly done on the scrap dock. Practically all of the work requires but one operation.

All work in the reclamation plant and on the scrap dock should be done piece work and all day work eliminated.

The size of the plant will depend on the size of the road, the number of plants on that road and the location and space available. The plant should be large enough to prevent congestion and so it can be arranged to handle material at the minimum cost. It is a mistake to build a plant, or any part of one, without a complete, comprehensive plan. Many of our reclamation plants are poorly laid out.

The machinery, tools, etc., will have to be selected to meet individual needs as well as the appropriation available. Second hand machinery and tools can often be used to good advantage, but in most cases discarded machinery and tools have outlived their usefulness and are expensive at any price.

[A list of machinery, tools, etc., for a fully equipped reclamation plant was here included in the report. The costs given were for a guide only.]

The cost of reclaiming is the governing factor as to whether material should be reclaimed or not. In arriving at this cost all the factors should be taken into consideration; cost of handling, cost of actual work oi reclaiming, interest, depreciation, etc., on the facilities which it is necessary to install to reclaim material and life of the material after it is reclaimed as compared with new articles. In many cases in reclaiming material we deceive ourselves by not taking all of the factors into consideration. What is possible to reclaim at a profit on one road is not on another, but there are a large number of items that it pays to reclaim on all railroads. In starting reclamation work, such articles should be reclaimed as valves, bolts, brakebeams, couplers, bolsters (welded with oxy-acetylene), bar-iron, etc., and then work into the other items as fast as facilities can be installed to reclaim them at a profit.

Material should be classified in accordance with the Railway Storekeepers' Association classification of material, and should be carried in these classifications as recommended in the Book of Rules and distributed and handled similar to store stock. Material should be shipped direct from the

reclamation plant wherever practicable; local conditions and shipping facilities, of course, will govern.

The cost of the plant will depend entirely on its size and the amount of work necessary to fit it for the work required. Wherever buildings are obtainable that are suitable for the work they should be used. However, railroads often lose sight of the savings that might be effected by having a plant built and arranged so that the cost of the work will be reduced to the lowest possible limit. The difference in cost of operation of a plant properly laid out and constructed and equipped with labor-saving devices, and one poorly laid out with inefficient equipment, will often pay for the improved plant in less than a year.

One of the strongest arguments against a reclamation plant is that there should be no need for one. It is claimed by many that material should not be allowed to get where it is necessary to reclaim it, and that by proper supervision and use of material there is no reason for a reclamation plant. However, experience shows that there is need for one.

Prevention requires the education of the users of the material by the men in charge, and by the store department. The storekeeper must watch issues of material and call attention to all cases where the old material should have been repaired and used, return old material for new and have old material repaired locally where it pays to do so, and where it does not, send it to the reclamation plant.

Educate the users as to the value in dollars and cents of the material they are using. One of the principal causes of misuse and waste of material is ignorance of its value in dollars and cents. While there are many people in large corporations who do not care for the waste they cause, the larger percentage by far of the employees cause waste through habit and ignorance of values. Object lessons well presented are one of the best ways to educate the users of material. A good method to prevent its being necessary to reclaim material is to make it hard occasionally to obtain, thus forcing the user to help himself.

The change in patterns and designs on account of increases in size and other causes is a big factor in the waste of material, and great care should be exercised before any change.

It is necessary to reclaim a large amount of material and work it over into something else on account of not having had proper care to preserve it. A little paint on steel and finished surfaces is often the cheapest reclamation work that can be done. Material in store stock, as well as charged out material of this kind, should be given the necessary attention to preserve it. It is not good practice to store cut nuts or material with finished surfaces in exposed places.

It does not pay to reclaim material at the point of origin where it involves extra handling or expense. However, where material can be reclaimed at the point of origin at less cost than at a reclamation plant, and where it can be repaired and distributed at the same cost as at a reclamation plant, it should be done. But there is danger of duplicating work and hidden expense in reclaiming at the point of origin.

As a rule scrap wharf facilities, as the term suggests, fall heir to what is left in the shop yard in the way of facilities. Wharves, buildings and storage bins for such purposes are usually the result of improvised and temporary structures. Many times the facilities are not only inadequate, but expensive to operate; still their general revision is delayed or prevented by the large outlay to change the plant as a whole, and for the reason that the very first preparations, which perhaps were necessary to meet an emergency, grew piecemeal until they precluded the re-arrangement for greater economy except at considerable cost. Oftentimes unsuitable buildings have been gradually built up with which inadequate facilities the local foremen are badly hampered in their work of handling, inspecting and assorting materials for re-use, repairs or sale.

The scrap dock should be organized so it will have adequate supervision for reclaiming material, and the men sorting scrap thoroughly instructed as to what material should be saved for the reclamation plant. The supervision should constantly inspect the sorting to see that no material is being sold for scrap that can be reclaimed. The profit or loss in reclaiming material is often determined by the handling. One good way to educate is to have a sample or exhibition place where samples or the material to be reclaimed can be seen by the men doing the work, and when mistakes are made, their attention should be called to them and the exhibit also. It has also been found economical to have a schedule so arranged that shop foremen and heads of various departments are permitted to take their turn at the wharf in the supervision of the work generally.

The physical handling will depend on local conditions. This, however, is a very important item in the reclamation of material, for, as a rule, excessive handling of reclaimed material will soon eat up the profit of reclamation. It should be an absolute rule that no scrap material of any kind be sold as such until it has been carefully inspected and all reclaimable material removed. Where material reclaimed can be used without any labor, it should be sent to the shipping room or proper storage room and thus eliminate all handling.

Records of car numbers and points from which material comes should be kept so that when material is put in the scrap that should not have been, the matter can be taken up with those at fault. The scrap dock should be so designed that the reclamation plant will be located to reduce the handling of the material to a minimum. Where this is impossible under present conditions, a comprehensive plan should be drawn up, showing the ideal conditions desired, and then work the scrap dock over a little at a time until the desired arrangement is obtained.

All material reclaimed should be inspected by a competent person to see that it is in condition to meet the requirements of its use. The foreman on the scrap dock can pass on this for the material shipped direct from the dock to the work, and the foreman or sub-foreman of the reclamation plant should do so for the material from the reclamation plant. Suitable testing machines should be provided for testing certain materials and gaging them to see that they will meet the requirements. There is much to be said for and against the practice of painting and marking material reclaimed. The committee feels that, generally speaking, material reclaimed should be painted, dipped or rattled.

[Detailed instructions and forms for handling the accounting for scrap and reclaimed material at a reclamation plant were here included in the report.]

The committee finds it impossible to make up a general statement of the saving made by the reclamation of material that would be applicable to all roads, or even to two or more roads, as conditions are so different. The saving will have to be worked up to suit individual needs for each item reclaimed. [Lists were given as a guide and to show what is being done at the present time on some of the roads.

The committee finds that the moral effect caused by reclaiming material saves many thousands of dollars. The man interested in the welfare of the company, by seeing the vast amount of material reclaimed, exercises much more care in the use of material and finds ways of using it that are cheaper than sending it to the reclamation plant.

The report is signed by D. C. Curtis (chairman), C. B. & Q.; D. D. Cain, S. A. L.; H. S. Burr, Erie; H. Scatchard, N. & W.; R. K. Graham, A. T. & S. F.; C. H. Rost, C. R. I. & P.; J. H. McMillan, N. Y. C., and H. G. Cook, S. P.

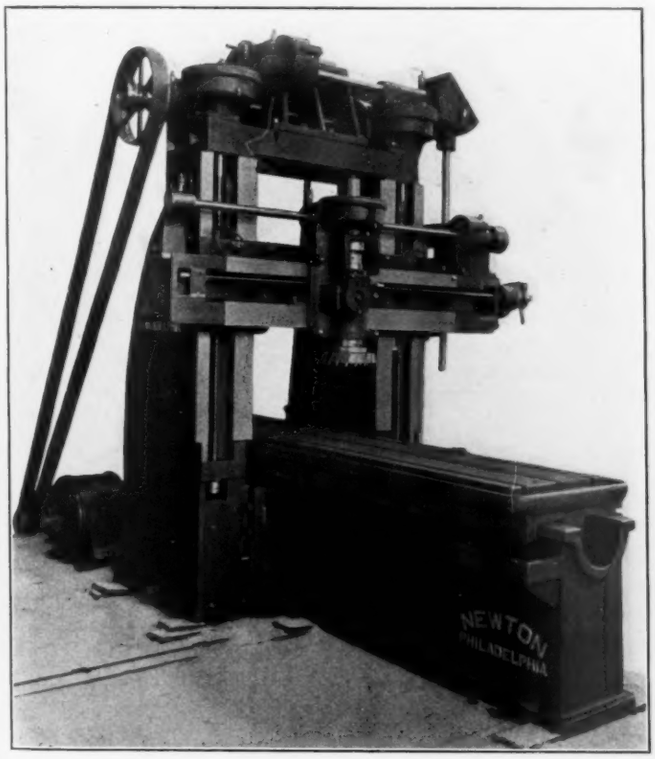
In presenting the report, the chairman of the committee regretted that the committee was unable to include details of the Great Northern rolling mill plant, but referred to a description which will be found elsewhere in this issue.

# NEW DEVICES

## VERTICAL SLABBING MACHINE

The illustration shows a newly designed vertical slabbing machine which is arranged to be driven by a single pulley. It will admit work 34 in. wide, and has a maximum clearance under the spindle of 36 in. The vertical spindle is driven by a bronze worm wheel and hardened steel worm fitted with roller thrust bearings running in oil. Spindle speeds ranging from 16½ to 99 r. p. m. are obtained by means of a gear box giving nine changes; the cross feed on the rail has twelve changes and a reversing fast power traverse. The spindle is 3⅛ in. in diameter in the driving sleeve and has a No. 6 Morse taper with a broad face key in the end for driving cutters. The spindle sleeve is adjustable by means of a hand controlled rack and pinion.

Auxiliary bushings which rotate with the shaft are carried by the spline shaft bushings to prevent the escape of oil and pre-




Single Pulley Driven Vertical Slabbing Machine

serve the fixed bushings from undue wear through contact with spline or keyseats.

The table has twelve feeds ranging from 3.55 in. to 13 in. per min., which are independent of the spindle speeds. In addition a rapid traverse of 30 ft. per min. is provided in both directions. All speeds and feeds are obtained through gear boxes, the gears being entirely encased in oil tight boxes. This machine is built by the Newton Machine Tool Works, Inc., Twenty-third and Vine streets, Philadelphia, Pa., and may be had with two, three or four spindles if desired.

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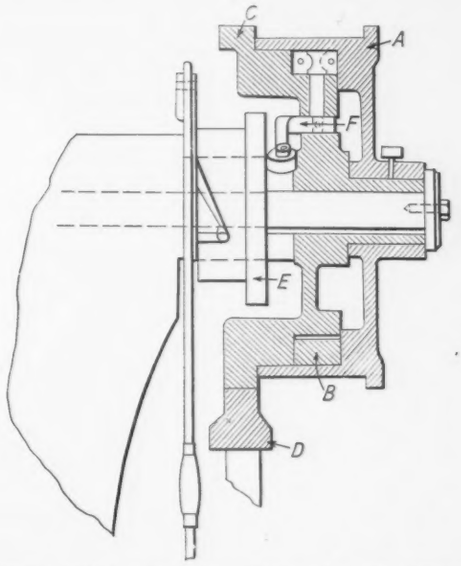
WATER POWER IN SWITZERLAND.—In Switzerland water power is conserved and utilized to such an extent that in some towns not an ounce of coal is used. Power, light and heat are furnished by water power.—*Power.*

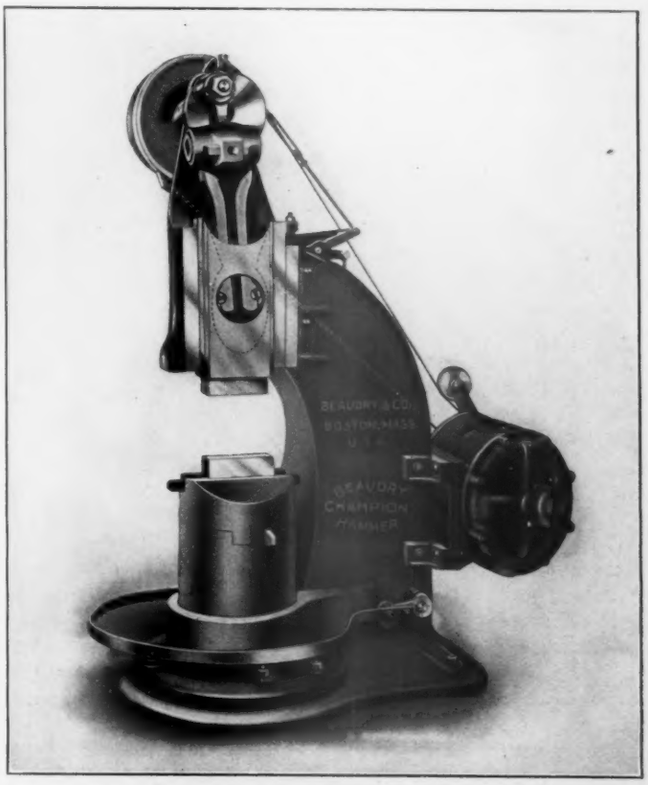
## MOTOR DRIVEN POWER HAMMER

The friction clutch shown in the engraving has been developed by Beaudry & Company, Inc., 141 Milk street, Boston, Mass., in connection with the application of individual motor drive to its




Friction Clutch for Motor Driven Beaudry Hammers

line of power hammers. This clutch makes possible the constant operation of the driving motor attached to the body of the machine without the use of a belt tightening device, while still re-



Application of Individual Motor Drive to a Power Hammer

taining the usual food-pedal method of control of the machine.

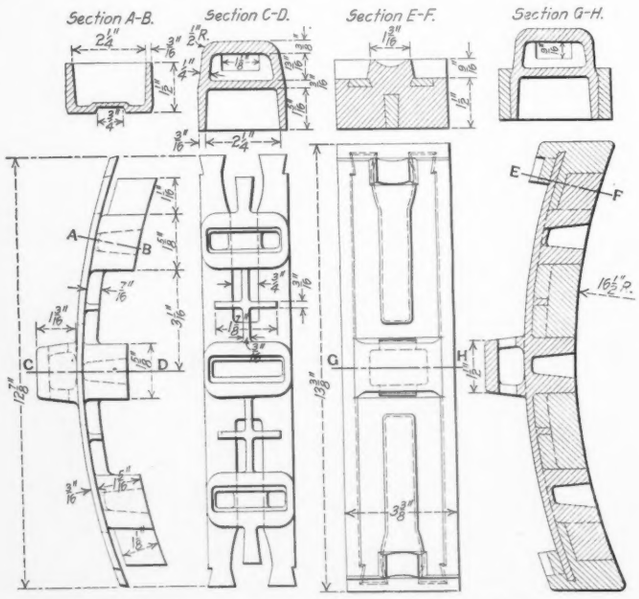
The clutch consists of a pulley *A* which runs loose upon the hub of the brake section *C*, the latter being keyed to the shaft. The friction ring *B* is split to fit the head of the expansion pin, which is operated by a lever *F*. This slot in the ring is provided with steel faces to withstand the wear. The cam *D* which operates the clutch is of the spiral type and is controlled by a rod suitably attached to the foot-pedal of the machine.

By varying the pressure of the foot-pedal the operation of the hammer may be perfectly controlled; as the pressure increases the force of the cam against the hardened steel roll in the end of the lever is increased and the expansion pin tightens the friction ring between the pulley and the brake section, the amount of slippage between these two members depending entirely upon the position of the cam. The operation of the brake is automatic, it being released when the hammer is in motion and applied on the release of the clutch.

## SAFETY BRAKE SHOE

A recently developed car wheel brake shoe of the insert type which is claimed to have given excellent results both in service and laboratory tests is shown in detail in the engraving. The body of the shoe is a special cast iron mixture poured around three inserts of malleable iron which form an integral part of the back and lug of the shoe. The inserts are rectangular in section and in the center of each is a dust pocket, the opening of which in the face of the shoe is ¾ in. wide by 2¼ in. long. The back of the shoe is so formed that it is well secured to the cast iron body and stiffening ribs are included on the inside.

A test of one of these shoes has recently been made at




Details of Brake Shoe with Dust Pockets in the Inserts

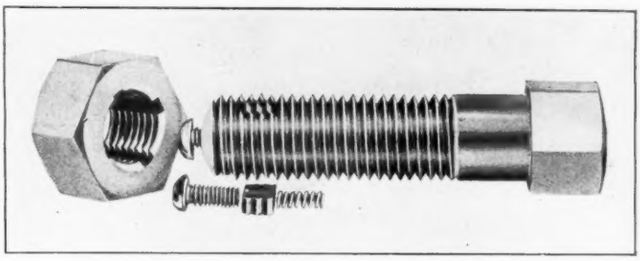
Purdue University and it is understood that the results were very favorable. When tested on a cast iron wheel at a pressure of 2,808 lb. it developed a coefficient of friction of 28.01 per cent; when the pressure was increased to 6,840 lb. the coefficient was 20.37 per cent. The coefficients required by the Master Car Builders' specifications are 22 and 16, respectively. A similar test on a steel wheel developed coefficients of 15.92 per cent at a brake shoe pressure of 6,840 lb. and 11.96 per cent at 12,000 lb., as compared with the specification requirements of 12.5 per cent and 11 per cent, respectively. On the steel wheel the loss in weight for each 100,000,000 ft. lb. of work done at an initial speed of 65 miles per hour was 1.04 lb., the specifications permitting a maximum of 4 lb. The average distance of stop on the steel wheel under 12,000 lb. brake shoe pressure was 890 ft. and under 6,840 lb., was 1,348 ft. On the cast iron wheel the average distance of stop under the low pressure was 881 ft., while under the high pressure it was only 440 ft.

This shoe is known as the Streeter safety brake shoe and the special features of its construction have been patented. Its development is in the hands of A. Mitchell, Bedford building, Chicago, Ill.

## A POSITIVE NUT LOCK

The illustration shows a nut locking bolt and nut of a positive locking type which is unlocked by means of a small set screw. This device was developed by Schum Brothers, Metropolitan Tower, New York.

The nut lock consists of three parts: a spring, a movable section and the set screw by which it is unlocked and held in position for the application of the nut. The movable section is applied to a slot through the bolt, in which it has an amount of longitudinal play equal to one-half the pitch of the thread. The spring is placed in a recess on the axis of the bolt toward the head from the movable section and the set screw is threaded



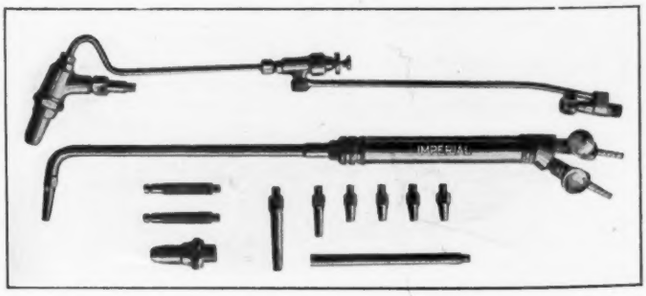
A Positive Nut Locking Device

into the end of the bolt. Four slots are cut in the bore of the nut to the depth of the threads.

In applying the nut the set screw is inserted in the end of the bolt and tightened against the movable section until the threads on both are in alinement. After the nut has been tightened the set screw is removed and when a slight turn of the nut brings one of the slots in line with the movable section the threads on the latter are forced out of alinement with those on the bolt by the action of the coil spring. The nut is thus locked and can only be turned after inserting the set screw in the end of the bolt.

## COMBINATION OXY-ACETYLENE WELDING AND CUTTING TORCH

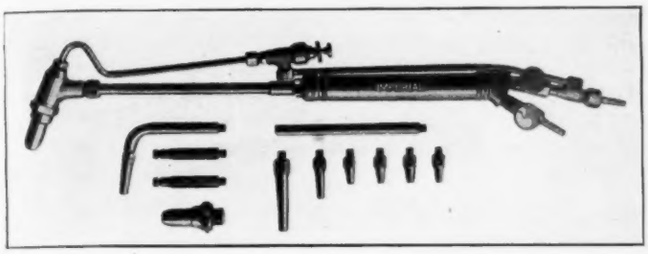
The illustrations show a combination oxy-acetylene torch adapted to both welding and cutting operations which has been brought out by the Imperial Brass Manufacturing Company, Chi-




Welding Torch Showing the Cutting Attachment Removed

cago. The welding equipment, as shown in one of the illustrations, is made up of the torch body and a sectional tube having straight

and curved extensions, to which interchangeable tips are applied. By removing the extension from the end of the tube the welding attachment may be applied, the end of auxiliary oxygen tube



Torch Arranged for Cutting, with Welding Head Removed

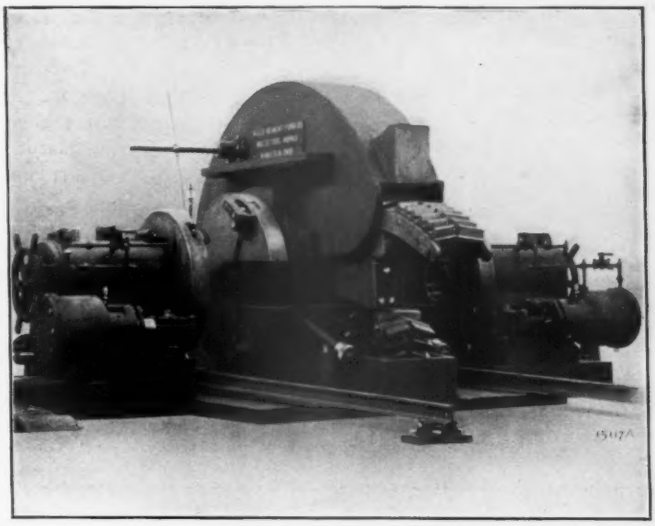
being inserted between the control valve on the torch body and the hose connection. A conveniently located valve for controlling the auxiliary oxygen supply forms a part of the cutting attachment.

## CENTER DRIVE CAR WHEEL LATHE

A center drive car wheel lathe developed by the Niles-Bement-Pond Company, New York, including several improved features has recently been built at its Niles plant. The improvement of greatest importance in the design of this machine is the use of the herringbone driving gear instead of the usual type of straight toothed gear. The lathe is designed to turn wheels from 28 in. to 42 in. in diameter on the tread and will take outside journals up to 6½ in. in diameter. The opening in the spool is 10 in. wide and accommodates axles up to 9½ in. in diameter; the maximum distance between centers is 94 in.

The herringbone driving gear is mounted on a spool revolving on large bearings in the bed of the machine. The ends of the spool are the face plates which carry the drivers. The driving gear is provided with a patented hinged segment which closes and locks automatically as the wheels are rolled into the machine and unlocks and opens automatically as they are rolled out, no manipulation being required by the operator. A motor driven elevating device operates a hinged track upon which the wheels are rolled into the machine, thus bringing them up into line with the center. The tail stocks, by which the wheels are centered, are moved on the bed and clamped to it by air cylinders, the operating valves of which are within easy reach of the operator.

Each face plate is equipped with three pairs of drivers engaging the inside of the wheel near its circumference. These are tightened by hand and exert a uniform pressure against the

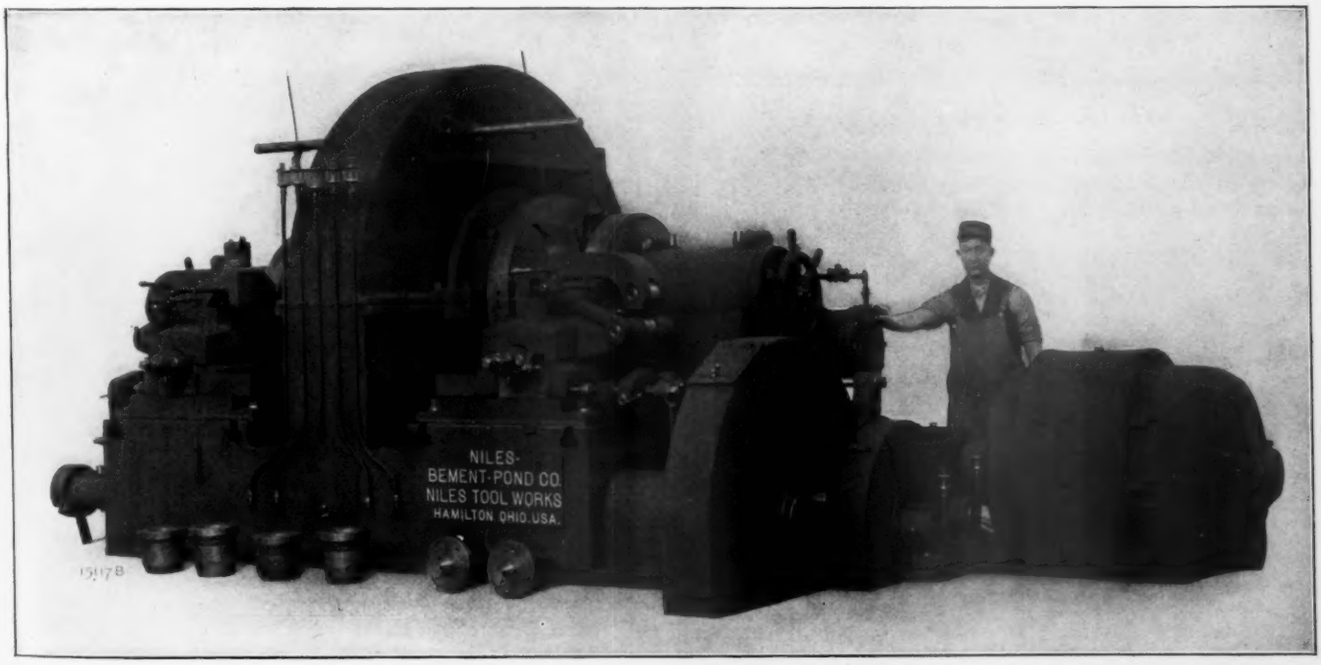


Back of the Car Wheel Lathe Showing Automatically Operated Gap in the Herringbone Gear

wheels. Independent chuck jaws on the tail stock faces engage the outside of the wheels and support them against the thrust of the drivers, relieving the axle of all deflection or torsional strains.

The tool rests are equipped with pneumatic tool clamps which enable the operator to change and clamp tools in a few seconds without the use of a wrench. The wedge action of the tool clamp forms a positive lock independent of the air pressure.

The power feed is directly gear driven and is positive in its action. It has a range from ⅛ in. to ⅝ in. per revolution of the face plate sustained by 6.4 feeding strokes per revolution, giving practically a continuous feed. The tool slide has a rapid



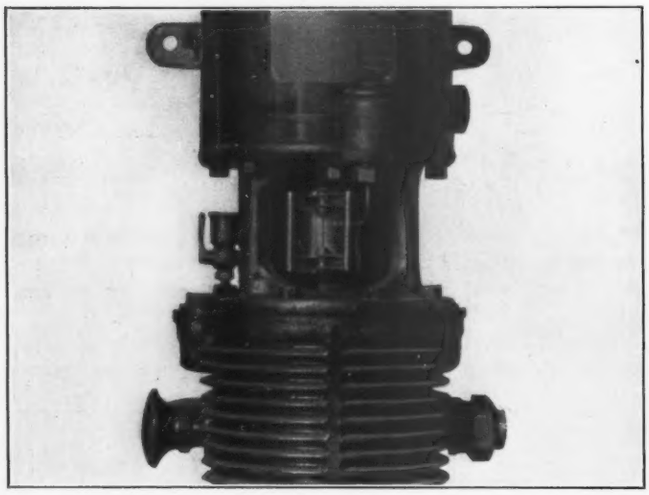

Operating Side of Center Drive Car Wheel Lathe

in and out adjustment and traverse by hand, the slide screws being fitted with ball thrust bearings to facilitate ease of operation. The tool rest can be swiveled to provide for tapering the wheel treads. A simple calipering device attached to the machine enables the operator to readily size both wheels to the same diameter.

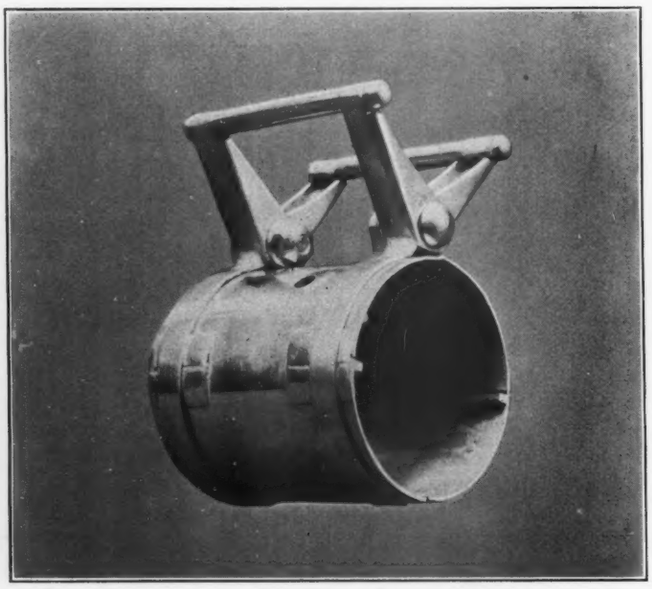
The lathe is driven by a 50-hp. variable speed motor and a 5-hp. constant speed motor is provided to operate the wheel lifting mechanism. When furnished for direct current both motors are equipped with dynamic brakes which enables the operator to stop the driving spool in any desired position and to accurately control the height of the wheels when lifting them to the centers of the tail stock. All gearing is thoroughly guarded and provisions are made to protect all bearings from dirt and chips.

## AIR PUMP GLAND NUT LOCK

A device for securely locking air pump gland nuts, which also serves as a protection to the swab against dust, has been developed by N. T. Cline, air brake foreman, Pittsburgh & Lake Erie at McKees Rocks, Pa. It consists of a split sleeve, the halves of which are hinged together and held in a closed position by means of springs applied to the hinges. In one of the illustrations the device is shown in place on the pump where it surrounds the two gland nuts and covers the intervening space occupied by the swab. The interior of the sleeve is provided with two internally projecting lugs at each end, which are designed to fit into the spanner grooves of the gland nuts when the latter are properly lined. Since these two nuts are tightened in opposite directions neither can slack off when the nut lock is in position without tightening the other, and both must, therefore, remain tight. The device may be readily removed and to prevent misplacement should be attached to the pump by a short chain. Oil holes are provided through the sleeve for oiling the swab.



Gland Nut Lock in Place on the Pump

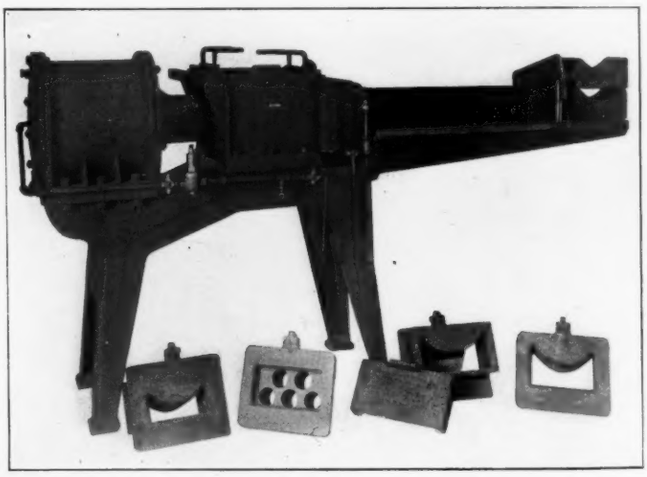


Nut Lock for Air Pump Glands

## HARD GREASE PRESS

A press for forming the grease cakes used in driving box lubricators, as well as candles for rod grease cups has been developed by the Franklin Railway Supply Co., 30 Church street, New York. The device consists of a box for holding the grease which is closed at one end by a plunger operated by a 16 in. by 12 in. air cylinder and at the other by the form through which the grease is pressed. A form cover which may be slipped over the end of the form is provided to facilitate compressing the grease in the box into a compact cake before it is pressed through the form.

When the cover is removed and air admitted to the cylinder, grease is forced out through the form onto a table where it may be cut into suitable lengths by means of the knife held between guides shown in the illustration. It being almost impossible to remove the form by hand from the end of the grease box, owing to the body of grease which is partly in the box and partly in the form, a small vertical cylinder has been placed under the form, with its piston acting against the bottom of the form. When air is admitted to the lower end of this cylinder the grease is sheared at the end of the box, and the form raised high enough so that it may be readily removed. A spring above the piston insures its return to the lower end of the cylinder when the pressure is removed.



Press for Forming Driving Box Grease Cakes

REPAIRING WAR SHIPS.—As an indication of the complete machine-shop equipment installed on some of the modern battleships and tenders, the following equipment of the U. S. S. Melville—a torpedo-boat destroyer tender—will be of interest: Three 22½-in. geared drills, two 16-in. friction-driven sensitive drills, one 24-in. portable radial drill, two double-emery floor grinders, one double floor buffer, two hacksaws, two center grinders. All these tools are electrically driven.—*American Machinist.*

# NEWS DEPARTMENT

The roundhouse, machine shops, car shops and a large part of the rolling stock of the Alaska Northern Railway (the government-owned road) at Seward, Alaska, were destroyed by fire on May 10.

The special committee on the Relations of Railway Operation to Legislation has issued a bulletin showing that on January 1 last there were in service in the United States 12,900 all-steel and 5,700 steel underframe passenger cars, and 43,512 wooden cars. Of the passenger cars acquired by the roads in 1914, 74 per cent were all steel; and of 956 cars under construction January 1, only three were of wood. Seventy-five per cent were all-steel.

## SPECIAL TRAIN TO ATLANTIC CITY MECHANICAL CONVENTIONS

The Pennsylvania Lines have announced that for the accommodation of those who will attend the conventions of the Master Mechanics' and Master Car Builders' Associations at Atlantic City next month, a special train will be provided, leaving Chicago at 5:30 p. m. on Monday, June 7, and arriving at Atlantic City about 5 p. m. the following day. The summer tourist fare will be $31.15 for the round trip, tickets good to return within 30 days, with an extra fare of $4.

## AIR BRAKE LAW MORE RIGID

In the United States Circuit Court of Appeals at Richmond, Va., May 4, the judges affirmed unanimously a decision of the District Court, holding it unlawful for a railroad to require the use of hand brakes to control the speed of trains while on the road; that is to say, presumably, at all places where the law requires the train to be equipped with air brakes in condition for use. The contention of the road was that, with long trains on descending grades, the use of the hand brakes, to supplement the air brakes, was necessary to safety. The court held, in substance, that excepting in extraordinary emergency the use of the hand brakes in such a situation is contrary to the air-brake law.

## MEETINGS AND CONVENTIONS

*Canadian Railway Club.*—At the thirteenth annual meeting of the Canadian Railway Club officers were elected as follows: President, L. C. Ord; first vice-president, R. M. Hannaford; second vice-president, George Smart; secretary, James Powell, and treasurer, W. H. Stewart. T. C. Hudson, E. E. Lloyd, J. Hendry C. Manning, E. B. Tilt and Prof. H. O. Keay were appointed on the executive committee, and W. S. Atwood, W. H. Winterrowd and F. A. Purdy on the audit committee.

*American Society of Mechanical Engineers.*—The Chicago section of the American Society of Mechanical Engineers held its last 1914-15 seasonal meeting May 14, 1915, at the La Salle Hotel, Chicago. An interesting paper on Electric Locomotives was presented by A. F. Batchelder and A. H. Armstrong, of the General Electric Company, Schenectady, N. Y. The following officers were nominated for the following year: H. M. Montgomery, chairman; Joseph Harrington, vice-chairman; Robert E. Thayer, secretary, and H. T. Bentley and C. E. Wilson as other members of the executive committee.

*American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.*—At the third annual convention of the American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association, to be held at the Sherman House, Chicago, from July 13 to 16, papers will be presented as follows: Autogenous Welding, by W. J. Moffett, C. Borcherdt and J. P. Hahn; Tinware, by A. Paulis and J. P. Shoemaker; Crude Oil Burners and Forges, by W. J. Hoffett and J. E. Harbough; Locomotive Jackets, by O. E. Schlink, W. W. Nash and T. J. Burke; Lubrication, by C. Borcherdt and A. D. Homer; Smoke Prevention, by J. G. Thompson and J. S. Richards; Metals and Their Alloys, by G. B. Hosford; Gaskets and Their Application to Locomotives, by F. Bucholtz; Coach Heating, by G. Schwenk and F. B. Gralike, and Piping, by W. E. Jones.

*National Association of Corporation Schools.*—The third annual convention of the National Association of Corporation Schools will be held at the Hotel Bancroft, Worcester, Mass., June 7 to 11 inclusive. The convention is held in Worcester this year as the result of an invitation tendered at last year's convention by three of Worcester's leading industrial concerns—the Norton Co., the Norton Grinding Co. and the American Steel & Wire Co.

The National Association of Corporation Schools was founded January 24, 1913, and its first meeting was held in New York University, New York. The functions of the association were designated as follows: to develop the efficiency of the individual employee; to increase efficiency in industry; and to influence courses of established educational institutions more favorably toward industry. The first annual convention of the association was held at Dayton, Ohio, September 16, 1913, and the second annual convention at the home of the Curtis Publishing Company, Philadelphia, Pa.

*Western Railway Club.*—The Western Railway Club held its annual meeting at the Hotel LaSalle, Chicago, on May 18. Dr. W. F. M. Goss presented a very interesting address on his experience in Germany at the time he visited that country for the purpose of studying locomotive superheater practice. He paid special tribute to Robert Garbe and Wilhelm Schmidt. Wilhelm Schmidt perfected the superheater and, which was by far the most arduous task, interested the imperial government in its adoption. Robert Garbe was the chief mechanical officer in charge of the superheater locomotives of the government lines and to him is due the success of the superheater in actual practice.

A unique form of entertainment was presented with W. E. Symons and the Boosters' Committee of the club as the leading actors. Mr. Symons attacked the Boosters' Committee in a most emphatic manner and had the entire assemblage thoroughly wrought up with his insinuations and accusations. This was carried to such a point that finally the president had to call on the Boosters' Committee to escort Mr. Symons to the refreshment room, and not until then was it apparent that his tirade was a part of the entertainment program. The following officers were elected for the ensuing year: President, H. H. Harvey, general car foreman, Chicago, Burlington & Quincy; first vice-president, W. E. Dunham, supervisor of motive power and machinery, Chicago & North Western; second vice-president, A. R. Kipp, mechanical superintendent, Minneapolis, St. Paul & Sault Ste. Marie; secretary and treasurer, Joseph W. Taylor; executive committee, A. LaMar, master mechanic, Pennsylvania Railroad; George S. Goodwin, mechanical engineer, motive power department, Rock Island Lines, and Edwin G. Chenoweth, mechanical engineer car department, Rock Island Lines. The secretary reported a total membership of 1,395 members and a cash balance of $132.54.

*American Society for Testing Materials.*—The eighteenth annual meeting of the American Society for Testing Materials

will be held at the Hotel Traymore, Atlantic City, N. J., June 22 to 26.

At the first session meeting, on Tuesday, June 22, at 11 a. m., opening business will be conducted and reports will be received from the committees on Standard Specifications for Coal, and on Standard Specifications for Coke.

At the second session, on Tuesday, at 3 p. m., reports will be received from the committees on Standard Specifications for Wrought Iron; Standard Specifications for Cast Iron and Finished Castings; Corrosion of Iron and Steel, and Standard Tests of Insulating Materials.

The subjects assigned for the remaining sessions are as follows:

Third, Tuesday, June 22, 8 p. m., Non-Ferrous Metals.

Fourth, Wednesday, June 23, 10 a. m., Steel.

Fifth, Wednesday, June 23, 8 p. m., Heat Treatment of Steel.

Sixth, Thursday, June 24, 10 a. m., Testing Apparatus. Among the four papers to be presented at this session will be one by C. D. Young, engineer of tests, of the Pennsylvania Railroad, entitled: The New Physical and Chemical Laboratory of the Pennsylvania Railroad at Altoona.

Seventh, Thursday, June 24, 3 p. m., Cement and Concrete.

Eighth, Friday, June 25, 10 a. m., Ceramics, Gypsum and Lime.

Ninth, Friday, June 25, 3 p. m., Preservative Coatings and Lubricants.

Tenth, Saturday, June 26, 10 a. m., Road Materials, Timber and Rubber.

Recreation periods are provided for Wednesday afternoon and Friday evening, and a smoker is announced for Thursday evening. Special rates have been secured in the hotel for the members of the society and their guests. In addition to the reports of the standing committees and the presentation of monographs on the special subjects, the convention will consider four proposed amendments to the by-laws affecting membership and the adoption of standards.

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*The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.*

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass.

American Railroad Master Tinners, Coppersmiths and Pipefitters' Association.—W. E. Jones, C. & N. W., 3814 Fulton street, Chicago. Annual meeting, July 13-16, 1915, Hotel Sherman, Chicago.

American Railway Master Mechanics' Association.—J. W. Taylor, Karpen building, Chicago. Convention, June 9-11, 1915, Atlantic City, N. J.

American Railway Tool Foremen's Association.—Owen D. Kinsey, Illinois Central, Chicago. Convention, July 19-21, 1915, Hotel Sherman, Chicago.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa. Convention, June 22-26, 1915, Hotel Traymore, Atlantic City, N. J.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth street, New York. Annual meeting, December 7-10, 1915, New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Sta., Chicago. Annual meeting, October, 1915.

Car Foremen's Association of Chicago.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, except July and August, Lytton building, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio. Annual meeting, September 14-16, 1915, Richmond, Va.

International Railway Fuel Association.—C. G. Hall, 922 McCormick building, Chicago.

International Railway General Foremen's Association.—William Hall, 1126 W. Broadway, Winona, Minn. Convention, July 13-16, 1915, Hotel Sherman, Chicago.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, Lima, Ohio. Convention, August 17, 1915, Philadelphia, Pa.

Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty street, New York.

Master Car Builders' Association.—J. W. Taylor, Karpen building, Chicago. Convention, June 14-16, 1915, Atlantic City, N. J.

Master Car and Locomotive Painters' Assoc. of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention, September 14-17, 1915, Detroit, Mich.

Niagara Frontier Car Men's Association.—E. Frankenberger, 623 Brisbane building, Buffalo, N. Y. Meetings monthly.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Convention, September 7-10, 1915, Hotel Sherman, Chicago, Ill.

# PERSONALS

*It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.*

## GENERAL

Henry Bartlett, mechanical superintendent of the Boston & Maine at Boston, Mass., has been appointed chief mechanical engineer, reporting to the president. He will have general supervision over matters connected with motive power and other equipment in so far as may be necessary to preserve the standards and systems of the railroad and to secure adherence thereto. All plans and specifications for locomotives and other equipment will be prepared by him and approved by the general manager. The construction of new equipment will be supervised by him and he will perform such other duties in connection with motive power and equipment as may be assigned to him by the president. Charles H. Wiggin, superintendent of motive power at Boston, will report to the general manager. He will have charge of all locomotives and car shops, engine houses and appurtenances, and of the maintenance, repair and inspection of locomotives and other equipment. The master mechanics, superintendents of shops, electrical superintendent, general car inspector, general air brake inspector and the general piece work inspector will report to him.

C. E. Brooks, general foreman at the Transcona, Man., shops of the Grand Trunk Pacific, has been appointed acting superintendent of motive power, with headquarters at Transcona, succeeding Joseph Billingham, resigned.

S. J. Hungerford, superintendent of rolling stock, western lines of the Canadian Northern, at Winnipeg, Man., has had his jurisdiction extended over the eastern lines.

Harry A. Macbeth, whose appointment as superintendent of motive power of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio, was announced in the May number, was born on September 23, 1867, at Wellsville, Ohio. He was educated in the common and high schools and entered railway service in October, 1883, with the New York, Chicago & St. Louis. He was machinist apprentice from 1884 until 1887, machinist from 1887 to 1891, gang foreman from 1891 to 1898, when he was appointed general foreman. This position he held until 1905, when he was appointed master mechanic, and he has served in that capacity for the last 10 years, recently with headquarters at Conneaut, Ohio, from which position he is now promoted to superintendent of motive power.

W. H. Winterrowd, mechanical engineer of the Canadian Pacific at Montreal, Que., has been appointed assistant to the chief mechanical engineer, with headquarters at Montreal.

## MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

T. C. Baldwin, whose appointment as master mechanic of the New York, Chicago & St. Louis at Conneaut, Ohio, was announced in the May number, was born in East Springfield, Pa., June 25, 1875. On finishing the grammar school he entered the office of the master mechanic of the Nickel Plate as a messenger boy, serving three years until November, 1892, as messenger and tool room boy. He then became a machinist's apprentice and after learning the trade served as a machinist and tool maker until January, 1904, when he was appointed machine shop foreman. In May, 1905, Mr. Baldwin was transferred to Buffalo, N. Y., as roundhouse foreman at that point where he served until May, 1910, again becoming machine shop foreman at that time and serving in that capacity until his recent appointment to the position of master mechanic.

J. H. MILLS, formerly master mechanic of the Ontario division of the Canadian Pacific at West Toronto, Ont., has been appointed master mechanic of the Lake Superior division at North Bay, Ont., succeeding H. G. Reid.

W. J. PICKRELL has been appointed master mechanic of the Ontario division of the Canadian Pacific at Toronto, Ont., succeeding D. T. Main, promoted.

W. C. SEALY has been appointed master mechanic of the Ontario lines of the Grand Trunk at Toronto, Ont., succeeding J. Markey, deceased. Mr. Sealy entered the service of the Grand Trunk in the erecting shop at Stratford, Ont., as an apprentice in 1901, having previously attended the high school at that point. The apprenticeship educational system had at that time just been inaugurated. He continued to serve at Stratford for about eight years as an apprentice, charge hand and finally as general foreman of the shop at that point. He was then transferred to Chicago as general foreman, in which capacity he was employed until 1913 when he was promoted to the position of assistant master mechanic of the Ontario lines. He occupied this position until May 1 of this year when he became master mechanic.

T. WINDLE, formerly master mechanic of the International & Great Northern at Palestine, Tex., has been appointed master mechanic of the Denver & Salt Lake, with headquarters at Tabernash, Colo.

### CAR DEPARTMENT

R. S. MOUNCE has been appointed general foreman of car repairs of the Erie Railroad at Jersey City, N. J., succeeding P. Fox, deceased.

L. C. WHITE has been appointed general car foreman of the Pere Marquette at St. Thomas, Ont., succeeding A. White.

F. B. ZERCHER, formerly superintendent of car shops of the Canadian Pacific at Montreal, Que., has been appointed master car builder, Eastern lines, with headquarters at Montreal.

### SHOP AND ENGINE HOUSE

H. G. BECKER, formerly general erecting shop foreman of the Lehigh Valley shops at Sayre, Pa., has been appointed general foreman of the Delaware & Hudson shops at Watervliet, N. Y., succeeding A. A. Masters, resigned.

WILLIAM BRANDT has been appointed general foreman of the shops of the New York, Chicago & St. Louis, at Conneaut, Ohio, succeeding T. C. Baldwin, promoted.

W. HOPE, formerly erecting shop foreman of the Canadian Northern at Joliette, Que., has been appointed foreman at Limoilou, Que.

F. P. HOWELL, formerly general foreman of the erecting shop of the Atlanta Coast Line at Waycross, Ga., has been appointed general foreman at Savannah, Ga.

T. S. LOWE, formerly master mechanic of the Canadian Northern at Limoilou, Que., has been appointed general foreman at that point.

J. A. MITCHELL, locomotive foreman of the Grand Trunk Pacific at Biggar, Sask., has been appointed general foreman at Transcona, Man.

A. MCTAVISH, formerly locomotive inspector of the Grand Trunk Pacific at Transcona, has been appointed locomotive foreman at Biggar, Sask.

WILLIAM H. NOLAN, general foreman of engine houses and shops of the Boston & Maine, at East Deerfield, Mass., has been given jurisdiction over the inspection and repair of rolling stock at that point and Greenfield, Mass.

T. W. PALOS has been appointed locomotive foreman of the Grand Trunk Pacific at Graham, Ont., succeeding R. G. Gilbride, resigned.

H. C. SPICER has been appointed general foreman of the erecting shop of the Atlantic Coast Line at Waycross, Ga.

J. A. WALTON has been appointed locomotive foreman of the Grand Trunk at London, Ont., succeeding J. R. Leckie, promoted.

### PURCHASING AND STOREKEEPING

WALTER R. OWEN, assistant purchasing agent of the Chicago, Rock Island & Pacific at Chicago, has been appointed assistant general purchasing agent, with headquarters at Chicago.

### COMMISSION APPOINTMENTS

A. L. MOLER has been appointed senior inspector of motive power for the eastern district, in the division of valuation, Interstate Commerce Commission, with headquarters at Washington.

## OBITUARY

PATRICK FOX, general foreman car repairs of the Erie Railroad at Jersey City, N. J., died on May 10 at the age of 56 years. Mr. Fox had been in the service of the Erie Railroad for nearly 40 years. He was employed in the Buffalo car shops from 1876 until March, 1886, where he served as car builder, gang foreman and shop inspector, until transferred to Jamestown, N. Y., as foreman at that point. In October, 1887, he was made foreman of car repairs at Galion, Ohio, in which capacity he served until the spring of 1892. He was then made general foreman of car repairs at Galion, Ohio, in which capacity he served until the spring of 1892. He was then made general foreman of car repairs at Huntington, Ind., and in April, 1902, was transferred to Buffalo, N. Y., as general foreman of car repairs at that point, where he remained until July, 1905. He then became general foreman of car repairs at Jersey City, N. J., which position he occupied at the time of his death.

JAMES MARKEY, master mechanic of the Ontario lines of the Grand Trunk at Toronto, Ont., died at his home there, April 22, at the age of 54 years.

P. P. MIRTZ, assistant engineer, mechanical department, of the New York Central, died suddenly on May 11, in New York.

# NEW SHOPS

CHICAGO, ROCK ISLAND & PACIFIC.—This company will build a small repair shop for light repairing at Biddle, Ark.

SOUTHERN RAILWAY.—In connection with new terminal facilities for this company at South Richmond, a contract has been awarded to Alsop & Pierce, Newport News, Va., for the construction of a new oil house to cost $6,975.

MORGAN'S LOUISIANA & TEXAS RAILROAD & STEAMSHIP COMPANY.—This company will construct new shop buildings and probably install some new tools and equipment at Algiers, La. The tools and equipment have not yet been definitely determined.

THE SEABOARD AIR LINE.—This company has let contracts to build a temporary shop building at Portsmouth, Va., as a temporary cover on a portion of the burnt shop area, but no decision has been reached for the construction of a permanent building.

NORFOLK SOUTHERN.—This company is putting up a small shed at the Raleigh, N. C., yards for the protection of workmen in placing steel underframes on cars. The building will be 40 ft. by 60 ft. The company has also provided additional tracks for handling about 75 cars at one time. The cost of the work will be about $5,000.

OREGON-WASHINGTON RAILROAD & NAVIGATION COMPANY.—This company will build a one-story, 10-stall roundhouse at Walla Walla, Wash. It will have brick walls, mill interior and concrete pits. The approximate cost will be $25,000. Moore Brothers, Portland, Ore., have been awarded the contract.

# SUPPLY TRADE NOTES

D. J. Normoyle has been appointed manager of the Philadelphia office of the Niles-Bement-Pond Company, Inc.

The Taylor Wharton Iron & Steel Company, Philadelphia, Pa., is working on an order for shrapnel shells at its Tioga plant.

Joseph F. Dixon, Jr., foreign sales manager of the Allis-Chalmers Company, died at his home in Brooklyn, N. Y., on April 30.

The Pyrene Manufacturing Company has moved its head offices in New York to the Vanderbilt Concourse building, 52 Vanderbilt avenue.

Charles Spalding, representative of the Gisholt Machine Company, Madison, Wis., in Chicago territory, has transferred his headquarters from the Chicago office to Detroit.

A. W. De Revere has been appointed district sales manager of the Terry Steam Turbine Company, Hartford, Conn., in charge of offices at 524 Monadnock block, Chicago.

The Pittsburgh plant of the American Locomotive Company, which has been virtually idle for two years, is being overhauled and plans are being made for a complete resumption of work.

H. S. Collette, secretary of J. G. White & Co., Inc., and the J. G. White Engineering Corporation, New York, has resigned from these companies and expects to reside permanently in California.

The Edgar Allen American Manganese Steel Company, Chicago, has changed its name to the American Manganese Steel Company. This company has foundries at Chicago Heights, Ill., and New Castle, Del.

The U. S. Metal & Manufacturing Company, New York, has been appointed eastern sales agent for the Union Fibre Company, Winona, Minn., makers of Linofelt for refrigerator and Feltlino for steel cars.

F. K. Irwin, formerly with the New York, New Haven & Hartford, has become connected with the Chicago office of the Niles-Bement-Pond Company. He will look after the railroad machine tool business in that territory.

The Standard Brake Shoe & Foundry Company, Pine Bluff, Ark., a new firm, has taken over the Dilley Foundry Company, and will start work at once on the construction of a new $40,000 plant, including an open-hearth steel foundry.

The Ballman-Witten Manufacturing Company, 5407 Easton avenue, St. Louis, Mo., has been incorporated with $100,000 capital stock to manufacture piston rings. Lathes and boring machines will be installed. E. C. Ballman is president.

The Pittsburgh Steel Car Company, Pittsburgh, Pa., has been incorporated at Dover, Del., with a capital of $100,000, and will manufacture and deal in steel railroad cars. The incorporators are Norman P. Coffin, Herbert E. Latter, Wilmington, Del., and Clement M. Enger, Elkton, Md.

H. E. Preston, formerly with the American Can Company, and prior to that with the Felt & Tarrant Manufacturing Company, Chicago, has joined the periodograph sales force of the Gisholt Machine Company, Madison, Wis., and will have headquarters at the company's Chicago office.

The item appearing in the May number, page 265, announcing the appointment of a new manager of the Boston branch of Manning, Maxwell & Moore, Inc., incorrectly gave the name of the new branch manager as J. S. Wright. The name given should have been Jos. Wainwright.

Fred A. Geier, president of the Cincinnati Milling Machine Company, Cincinnati, has purchased the interest of Larz Anderson in the Cincinnati Shaper Company and the Cincinnati Gear Cutting Machine Company, Cincinnati. P. G. March will continue as president, and the business will be extended.

E. E. Winship, formerly manager of the Cincinnati branch of Manning, Maxwell & Moore, Inc., has been appointed manager of the Cleveland branch, effective May 1. C. H. Overkamp, formerly of the Conover-Overkamp Machine Tool Company, Dayton, Ohio, has been made manager of the Cincinnati office.

The operation of the plant of the Continental Car & Equipment Company at Highland Park, Louisville, Ky., which was shut down when the company went into bankruptcy, will be resumed by the Continental Car Company, which has been incorporated with $40,000 capital stock by A. H. McKinley and others.

The Davis Manufacturing Company, Milwaukee, Wis., manufacturer of gasolene motors, has closed a contract with the Railway Engineering & Equipment Company, Indianapolis, Ind., for the construction of motors, trucks and underframes for the entire output of railway coaches of the latter company for a period of five years.

P. H. Biggs, sales manager of the Cleveland territory of Manning, Maxwell & Moore, has resigned from that position and has taken an office in the Schofield building, Cleveland, Ohio, under the name of the P. H. Biggs Machinery Company. He will handle machine tools and hydraulic machinery, and represent a limited number of manufacturers in the northern Ohio territory.

The Whiting Foundry Equipment Company, Harvey, Ill., has taken over the foundry equipment business of the Central Iron Works, Quincy, Ill., thereby adding to its line the dust arresters and water cinder mills formerly manufactured by that company. The Whiting Company has retained one of the engineers of the Central Iron Works. It will also be prepared to furnish repairs for Central Iron Works equipment.

The Pittsburgh Steel Car Company, recently organized by Pittsburgh capital, is planning to erect a plant at Greenville, Pa., which will provide for a capacity of 7,500 steel cars a year. The officers of the company are W. A. Scott, Jr., president; H. B. Scott and L. A. Meyran, vice-presidents; H. W. Best, treasurer; George W. Ramby, secretary, and E. B. Caughey, office manager. The offices are at 512 Ferguson building, Pittsburgh.

Laurence Hamill,, for some time district agent for the Buda Company, Chicago, and W. B. Hickox, formerly in charge of sales of the Adams Bagnall Electric Company, Cleveland, Ohio, have formed the Hamill-Hickox Company, with offices in the Hickox building, Cleveland. The new company will act as direct representatives in Ohio and surrounding territory for railway supplies, and will continue to handle the Buda Company account and several others.

The Pacific Great Eastern Equipment Company has been incorporated with a capital of $3,000,000 and office in Vancouver, B. C., to purchase, hire or manufacture railway cars, locomotives or other rolling stock, deal in rails, contractors' equipment, appliances and tools, and to sell or hire the same to railway companies and contractors. The provisional directors are: P. Welch, E. F. White, E. W. Kaufmann, A. H. Sperry and D. C. Pennington, Vancouver, B. C., all of whom are associated with the Pacific Great Eastern Railway.

The Reading-Bayonne Steel Casting Company has recently sold its Bayonne, N. J., plant to the Bayonne Steel Casting Company, and its Reading, Pa., plant to the Reading Steel Casting Company. The Bayonne Steel Casting Company has elected officers as follows: William D. Sargent, president and treasurer, and A. J. Passino, secretary. H. K. Pollard has been appointed sales manager, and Charles Lidstone, superintendent. The officers of the Reading Steel Casting Company are: J.

Turner Moore, president; M. G. Moore, vice-president; H. M. Doty, secretary and treasurer; M. G. Moore is also sales manager, and J. Douglas Genger, superintendent. The Reading-Bayonne Steel Casting Company was a combination of these two companies organized about December, 1911.

Charles William Sherburne, who died in Boston, Mass., on May 6, after an illness of three years, was the founder of the railway supply firm of Sherburne & Co., Boston, Mass., and had been at its head for about 50 years. Mr. Sherburne was born in Boston on October 13, 1839. He was for a time employed on the Vermont & Canada, now a part of the Central Vermont, but soon returned to Boston to engage in the railway supply business, under the name of Sherburne & Co. Mr. Sherburne was a very active man, and until within a few years he was president of the Armstrong Transfer Express Company, president of the Star Brass Manufacturing Company, a director of the Armstrong Dining & News Company, and treasurer of the New England Railroad Club.

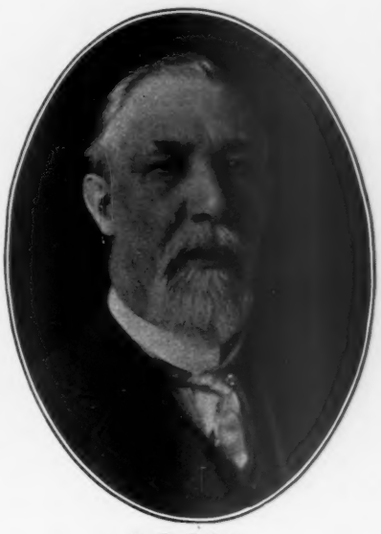
C. W. Sherburne

C. B. Yardley, Jr., at present eastern railroad representative of the William C. Robinson & Son Company, Baltimore, Md., with office at New York, will on June 1 become manager of the railway department of the Lubricating Metal Company, 2 Rector street, New York. Mr. Yardley was for a time manager of the railway department of the United States Metal Products Company, and previous to that was for several years railroad representative of Jenkins Brothers, New York. He is a prominent member of the Railway Supply Manufacturers' Association. In 1912-1913 he served as chairman of the enrollment committee of that organization, and at present is chairman of its badge committee. He has also served as secretary and treasurer of the Railway Materials Association, which is associated with the Railway Storekeepers' Association, and in May, 1914, was elected president of that organization.

C. B. Yardley, Jr.

The Westinghouse Electric & Manufacturing Company, which has received a large order for rifles from the British government, has practically completed negotiations for the purchase of the plant and business of the J. Stevens Arms & Tool Company, of Chicopee Falls, Mass., and the plants of the Stevens-Duryea Company in Chicopee Falls and East Springfield. The company plans to fill the order at these plants. L. A. Osborne, vice-president of the company, will be in executive charge of the work, and Walter L. Clark, recently vice-president of the Niles-Bement-Pond Company, will be manager of the combined plants in charge of operations. The corporate and commercial identity of the J. Stevens Arms & Tool Company will be retained, and its usual line of rifles will be manufactured. When the war order rush is over the other plants will probably be devoted to the manufacture of the usual line of Westinghouse products.

George T. Reiss, vice-president of the Niles Tool Works Company, and a director of the Niles-Bement-Pond Company, died at his home in Hamilton, Ohio, on May 5. Mr. Reiss had been in the employ of the Niles Tool Works Company continuously since 1878. He was born in Cincinnati, December 6, 1849. In 1877 he went to Hamilton. He was first employed there as a draftsman, but in 1878 he was given the position of master machinist with the Niles Tool Works Company, and placed in charge of the company's engineering department. He was subsequently chief mechanical engineer and later superintendent of the drafting department. Eventually, he became vice-president of the company and a director of the Niles-Bement-Pond Company. He was an inventor of considerable importance and held a position of prominence in the affairs of the city in which he made his home.



G. T. Reiss

William Sterling Hodges, of the Baldwin Locomotive Works, with his wife and two sons, was lost in the sinking of the Lusitania. Mr. Hodges was born in Philadelphia on March 1, 1882, and was a graduate of the Central Manual Training School. He entered the drafting department of the Baldwin Locomotive Works on December 18, 1899. In July, 1912, he went to China as technical representative. He remained there about two years, returning in the summer of 1914. In September, 1914, he went to Russia and remained there until the middle of December. Early in January, 1915, he was assigned to duty as technical representative or agent in Paris. He went there with the intention of returning in April to take his family back with him to France. He returned to this country on the Lusitania when that vessel made her last trip westbound, and a week later, with his family, sailed on the same ship. Mr. Hodges showed great capability as a designer in locomotive construction. He patented a number of devices, the best known of which is the trailing truck bearing his name.

W. S. Hodges

# CATALOGS

Air Meters.—A four-page folder has been issued by the New Jersey Meter Company, Plainfield, N. J. This folder is devoted to the Tool-om-eter, a recently developed form of air flow meter. This device is adapted to checking the amount of compressed air used by the various types of portable pneumatic tools.

Wiring.—The Fargo Manufacturing Company, Inc., Poughkeepsie, N. Y., has recently issued catalog No. 800, which deals with its types "A" and "B" connecting devices for electric wiring. The catalog is well illustrated with sectional drawings and engravings showing the construction of the various types of connectors.

Riveters.—Catalog No. 3 of the Vulcan Engineering Sales Company, Chicago, deals with a line of pneumatic riveters manufactured by the Hanna Engineering Works, Chicago. These machines are of a variety of types and sizes, the special feature of the line being the toggle motion by which the power is transmitted to the ram.

Arch Tube Cleaners.—Catalog W-1 of the Lagonda Manufacturing Company, Springfield, Ohio, is devoted to its line of arch tube cleaners. Several types of cutting heads are shown and a number of accessories are listed, including repair parts. In addition to the pneumatic cleaners, water and steam driven cleaners are shown.

Expanded Metal Lath.—Kno-Burn expanded metal lath is the subject of a 52-page booklet issued by the North Western Expanded Metal Co., Old Colony Building, Chicago. The advantages claimed for this type of lath are outlined in detail, stock sizes and weights are given and a large number of illustrations are included giving details of application.

Wagon and Truck Loaders.—This is the title of book No. 210 of the Link-Belt Company, Chicago, which is devoted to a line of portable loaders for use in handling coal, sand, stone, gravel and other loose material from storage piles into wagons, trucks or cars. The book has 47 pages and is profusely illustrated with photographs taken in service.

Water.—The Kennicott Company, Chicago Heights, Ill., has recently issued a pamphlet entitled Water, Its Storage Purification and Measurement for Industrial Purposes, in which are set forth the advantages of soft water as applied to various industries. It contains several illustrations of Kennicott water softener plants and other equipment manufactured by this company.

Portable Air Compressors.—Form No. 3,015 issued by the Ingersoll-Rand Co., 11 Broadway, New York, contains 32 pages, 6 in. by 9 in., and is a complete treatise on the subject of portable air compressing outfits. A list of bulletins is given describing in detail each particular line of portable compressors as well as catalogs of the various pneumatic tools and equipment mentioned.

Safety Rules.—The Whiting Foundry & Equipment Company has recently issued a poster containing safety rules for cranemen, crane operators, floor men and repair men. The poster has the words "Safety First" printed in large red letetrs at the top and the rules are from a safety bulletin issued by the National Founders' Association. The poster is suitable for placing in shops for the guidance of workmen.

Air Compressors.—Bulletin No. 34 M, dated March, 1915, and issued by the Chicago Pneumatic Tool Co., describes the class O "Chicago Pneumatic" steam and power driven compressors. The bulletin contains 36 pages, including detailed illustrations of the various parts of these compressors as well as indicator diagrams showing the results obtainable by their use. Tables are included giving the principal data for the various sizes.

Vacuum Car Cleaners.—A four-page leaflet entitled bulletin No. 221 A, has been issued by the Thurman Vacuum Cleaner Co., St. Louis, Mo., describing the Thurman No. 2 portable electric car cleaning device. This vacuum cleaner is placed at the side of the coach to be cleaned, and is driven through an electric lamp cord from the lighting circuit in the coach or the terminal yard. The system is now in use on over 25 American railways.

Hydraulic Forcing Presses.—This is the subject of catalog No. 92, issued by the Watson-Stillman Company, New York. This Book contains 128 pages, thoroughly illustrated and deals with a large number of forcing and miscellaneous presses which this company manufactures. The catalog supersedes catalog No. 70 and part of No. 82. It has been found convenient to divide the various tools into classes, making each class the subject of a catalog. At the back of this book a list is given of these classified catalogs.

Window Devices.—The McCord Manufacturing Co., Detroit, Mich., has issued a 56-page catalog dealing with the Universal window devices which this company manufactures. The book is handsomely gotten up and illustrated in color engravings as well as line drawings, the latter giving in detail the arrangement of the different window fixtures. These include weather stripping, locks and racks, sash lifts, anti-rattle bearings, stop casings and parting strips, sash balance brackets, sash balance chain connections, metallic sash, deck sash ratchets, etc.

Cranes.—Book No. 107, issued by the Industrial Works, Bay City, Mich., illustrates and describes the various crane equipment which this company manufactures. This includes wrecking cranes, pile drivers, locomotive cranes, lifting magnets, etc. A section is also devoted to other products such as pillar and transfer cranes, rail saws, transfer tables and wrecking tools. The book contains 88 pages and an insert containing illustrations of a partial set of Industrial wrecking tools. The printing and illustrations are excellent, a high grade of paper being used.

Locomotive Stokers.—The Locomotive Stoker Company, Schenectady, N. Y., in its catalog No. 14-B issued in April, has compiled a list of locomotives to which the Street stoker has been applied. The catalog is a neatly arranged booklet of some 50 pages containing a full-page illustration of each locomotive class to which the stoker has been applied with a table of the principal dimensions and a statement on the facing page of the number of engines equipped. The fact is brought out that at the present time there are in service over 600 locomotives fired by the Street stoker.

Speed Reducing Gear.—Catalog "A" of the Turbo-Gear Company, Industrial building, Baltimore, Md., is devoted to the Turbo reducing gear recently developed by this company for high ratio speed reduction. This device consists of a stationary annular gear, a pinion cut integral with the high speed shaft and intermediate gears, the shafts of which are secured to the cast steel slow speed member. The intermediate gears mesh with the annular gear and the pinion, revolving about the latter. All the gears are of the double helical or herring bone type, and are enclosed in a cast iron housing.

Paints.—The St. Louis Surfacer & Paint Company, St. Louis, Mo., has issued a number of circulars and color cards, each one devoted to paints and varnishes for a particular class of work, all of which are neatly bound in a loose-leaf folder. Among the circulars are found the following dealing with paints for railway work: No. 1-A, steel and wood freight car paint; No. 2-A, coach and car surfacer; No. 3-A, locomotive surfacer; No. 5-A, canvas roof paint, floor paint and truck enamel; No. 6-A, hand rail and headlining enamel, rattan seat finish and interior car colors; No. 7-A, coach colors and color varnishes; No. 8-A, station and building paint; No. 9-A, bridge and signal target paint, and No. 14-A, car cleaner and metal polish. A color card is included with each circular.